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Fur Seal Investigations, 1985

Edited by
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and
Hiroshi Kajimura

September 1988

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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FUR SEAL INVESTIGATIONS, 1985

Edited by

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September 1988

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ABSTRACT

Northern fur seal (Callorhinus ursinus) research in 1985 was conducted on the Pribilof Islands and Bogoslof Island in Alaska, and on San Miguel Island and nearby Castle Rock in southern California.

Estimates made of the number of pups born in 1985 on St. Paul Island showed a slight but insignificant increase since 1984, whereas the pup population in 1985 on St. George Island decreased by about 8.2% since 1983.

Enlarging on previous studies, larger samples of maxillary canine teeth collected from males taken in the harvest were weighed for the years 1948-84. This study (confirmed that a density-dependent increase in tooth size occurred as the population declined.'

[Duration of feeding trips and reproductive success were examined for 47 females! 20 early-pupping, older females were compared to 27 late-pupping, young females. Early-pupping, older females had significantly shorter trips to sea ($X=4.48$ days) than did late-pupping, young females ($X=6.70$ days). By October, just prior to weaning, 34.6% of the pups of the young females had died, whereas only 7.4% of the early-pupping, older females had lost their pups.

Surveys of entanglement among young males were accomplished by capturing, tagging, and recording the nature of their entanglement. Control animals were tagged for future estimates of mortality rates.

In October, studies with captive pups demonstrated that trawl netting with mesh sizes as small as 15 cm (stretched mesh) present a risk of entanglement.

Surveys indicate entanglement rates in adult females on sample rookeries varied from 0.06 to 0.23% in 1985. Experimental entanglement resulted in doubling of feeding trip duration for adult females; up to one-half of experimentally entangled females did not return from their first, second, or third feeding trips. A total of 25 entangled juvenile females and 39 entangled pups were observed during late season surveys.

Serum samples were collected from 300 subadult males and 37 pups; - the pups were also given rectal swabs for calcivirus isolation studies.

Swim speeds of foraging females were greatest (3.5 m/second or 12.6 km/hour) during deep dives. Intragroup density of females did not decline as the population declined over the past 10 years, but remained relatively stable.

Radio transmitters and aerial surveys were used to study movement patterns of female northern fur seals at sea during June and July 1985. As in 1984, fur seals were located principally to the northwest and southwest of St. Paul Island at feeding locations about 205 km from the island.

Pelagic studies were conducted near the Pribilof Islands during August 1985, to assess food habits of fur seals in relation to prey abundance and distribution. Forty-three fur seals were collected and their digestive tracts analyzed; 23 midwater and 23 bottom trawls were also completed and the catch analyzed. Comparisons between fur seal prey items and species diversity and abundance from the trawl catches are currently being analyzed.

The small rookery at Bogoslof Island was surveyed during August 1985, and was found to contain about 103 fur seals older than pups and at least 9 pups.

The number of fur seal pups born at San Miguel Island decreased from 889 in 1984 to 781 in 1985. Estimates for the total number of females in the population were not obtained, although the number of pups born suggest that females numbers may have also decreased. The number of males has not appeared to have changed significantly in the past several years.

Mortality of pups at Adams Cove and Castle Rock was 3.7% and 3.4%, respectively.

Information obtained in 1985 indicates that 94.0% of the female population at Castle Rock and Adams Cove was composed of animals older than 6 years of age. During 1970-73, 10.0 to 35.0% of the female population was younger than 7 years of age.

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INTRODUCTION

by

Charles W. Fowler and Patrick Kozloff

In 1985, the United States, Canada, Japan, and the Soviet Union cooperatively carried out research on the northern fur seal, Callorhinus ursinus, on land and at sea. Scientists from the National Marine Mammal Laboratory (NMML) in Seattle, Washington, have routinely conducted annual surveys and studies on U.S. islands under terms of the Interim Convention on the Conservation of North Pacific Fur Seals. Although this Convention lapsed in October of 1984, studies have continued annually by former member nations. In particular, studies have been conducted on the Pribilof Islands and Bogoslof Island in Alaska and San Miguel Island off southern California where fur seals breed and haul out. This report summarizes the research carried out on these islands in 1984 and 1985.

The Pribilof Islands of St. Paul (Fig. 1), St. George (Fig. 2), and Sea Lion Rock (Fig. 1 - Sivutch) are host to breeding populations of northern fur seals. Two additional colonies containing approximately 2,000 to 4,000 northern fur seals breed on San Miguel Island and nearby Castle Rock off southern California (Fig. 3). A small colony of fur seals now breeds on Bogoslof Island, Alaska. The colony began in 1980 and in 1985 included about 112 animals.

In 1985, fur seals were not commercially harvested on St. Paul Island. However, a total of 3,379 juvenile male fur seals (primarily 3-year-olds) were taken for subsistence.

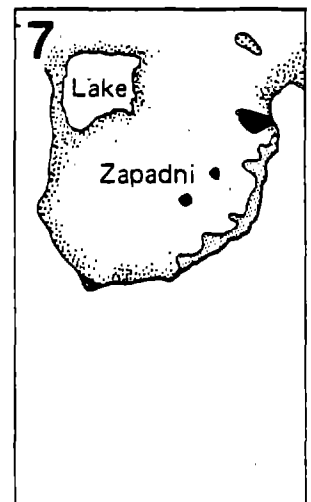
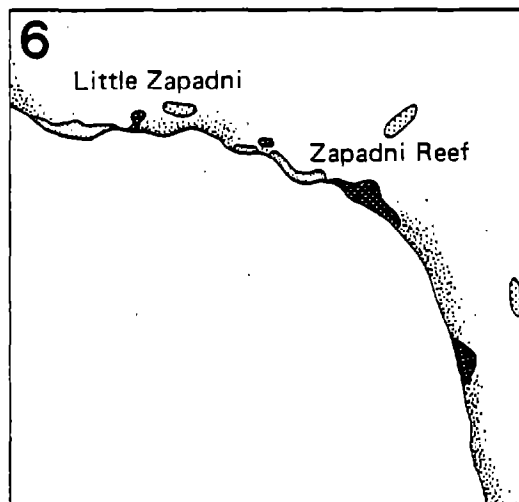
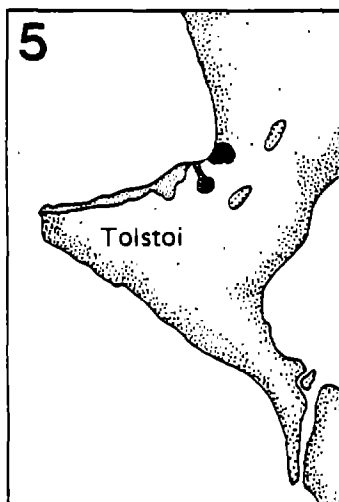
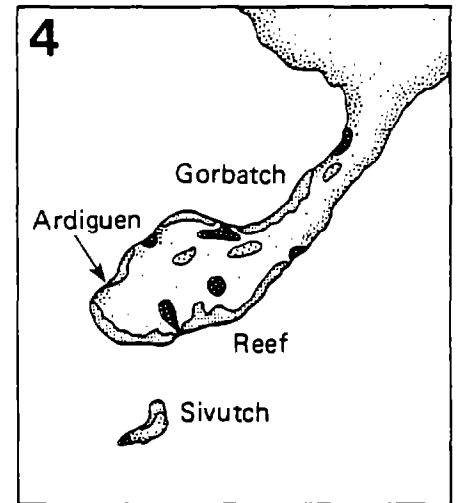
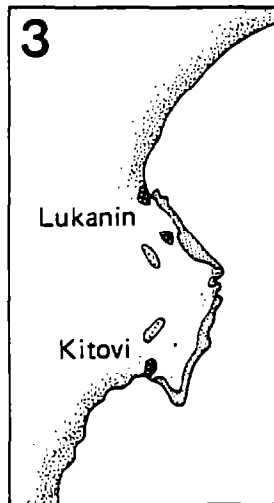
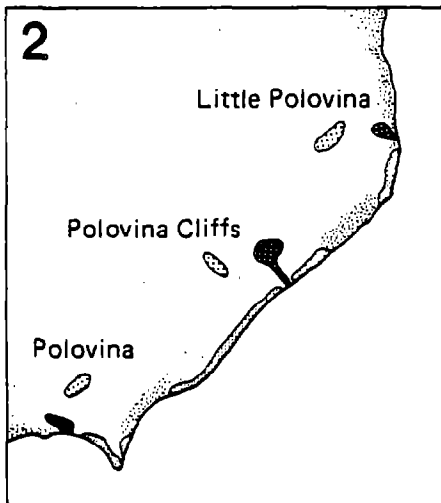
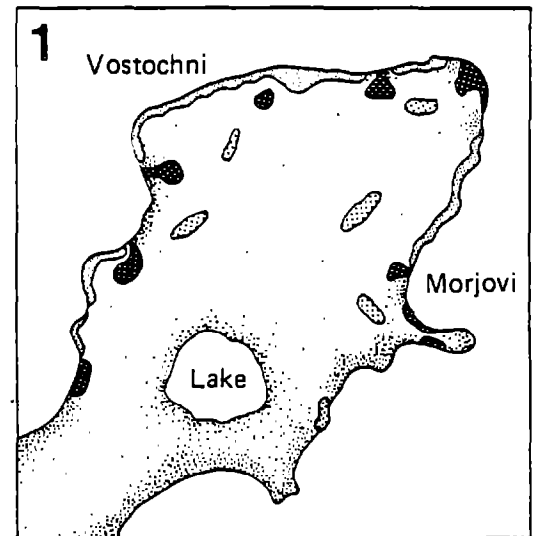
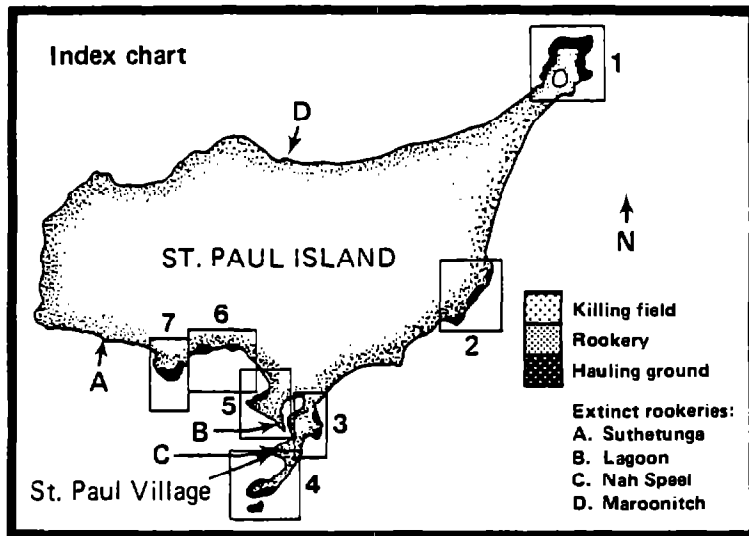


Figure 1.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. Paul Island, Alaska.

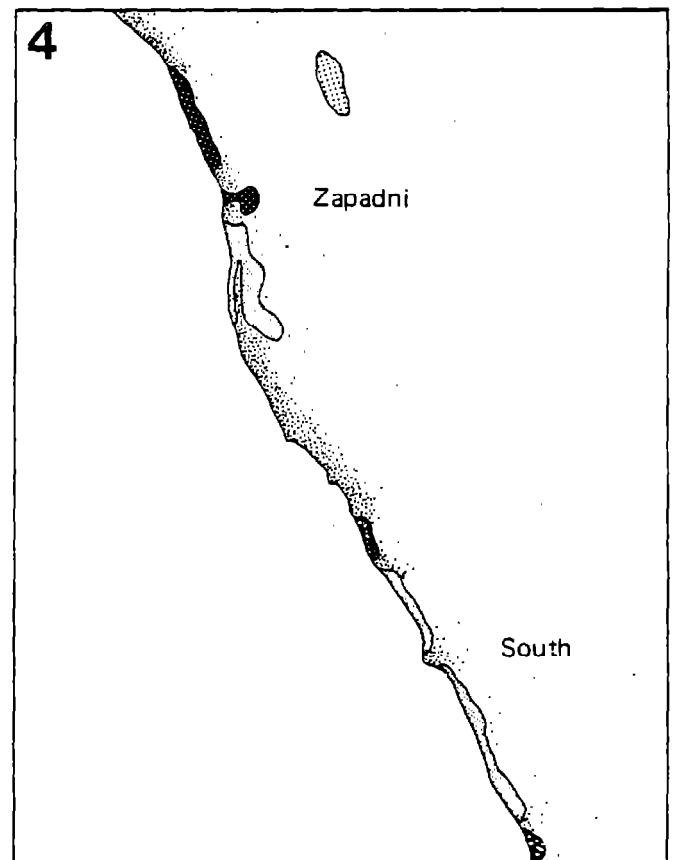
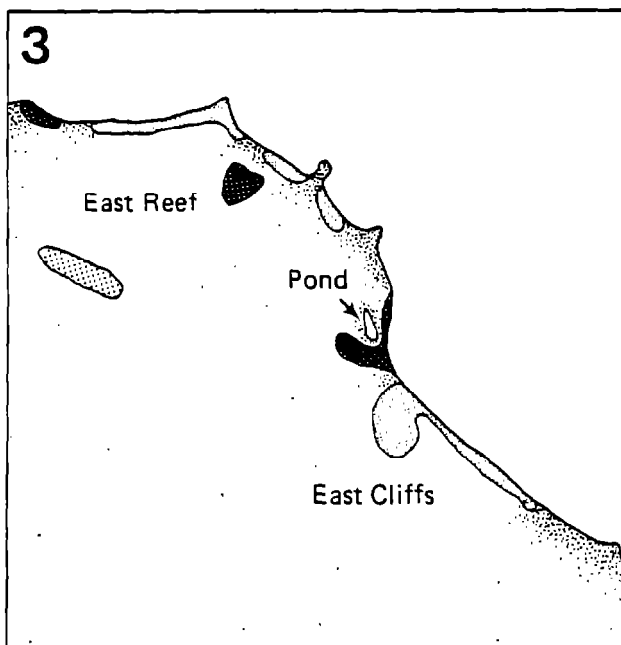
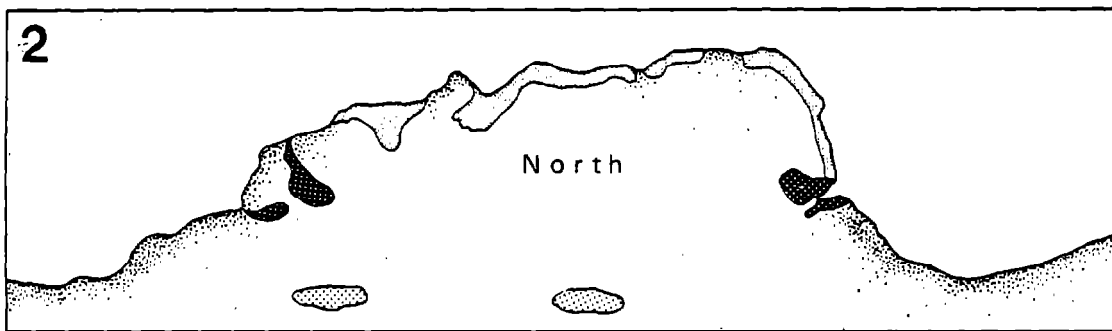
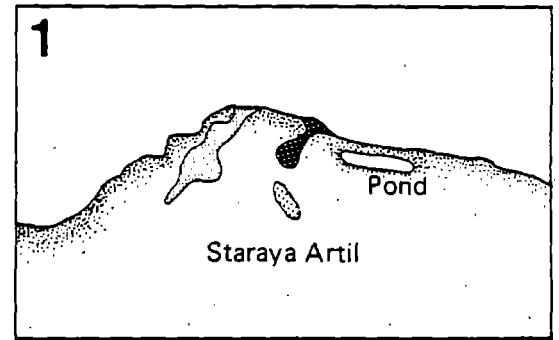
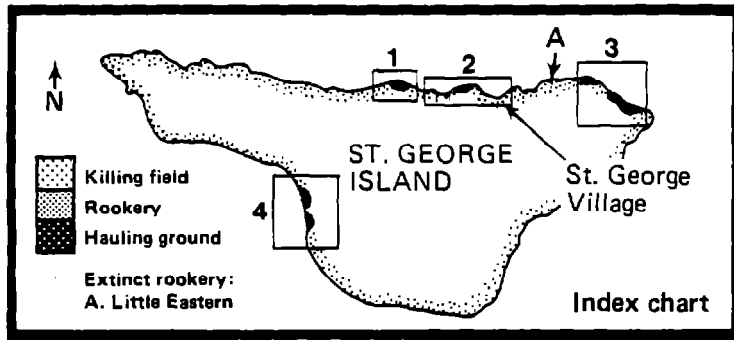


Figure 2.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. George Island, Alaska.

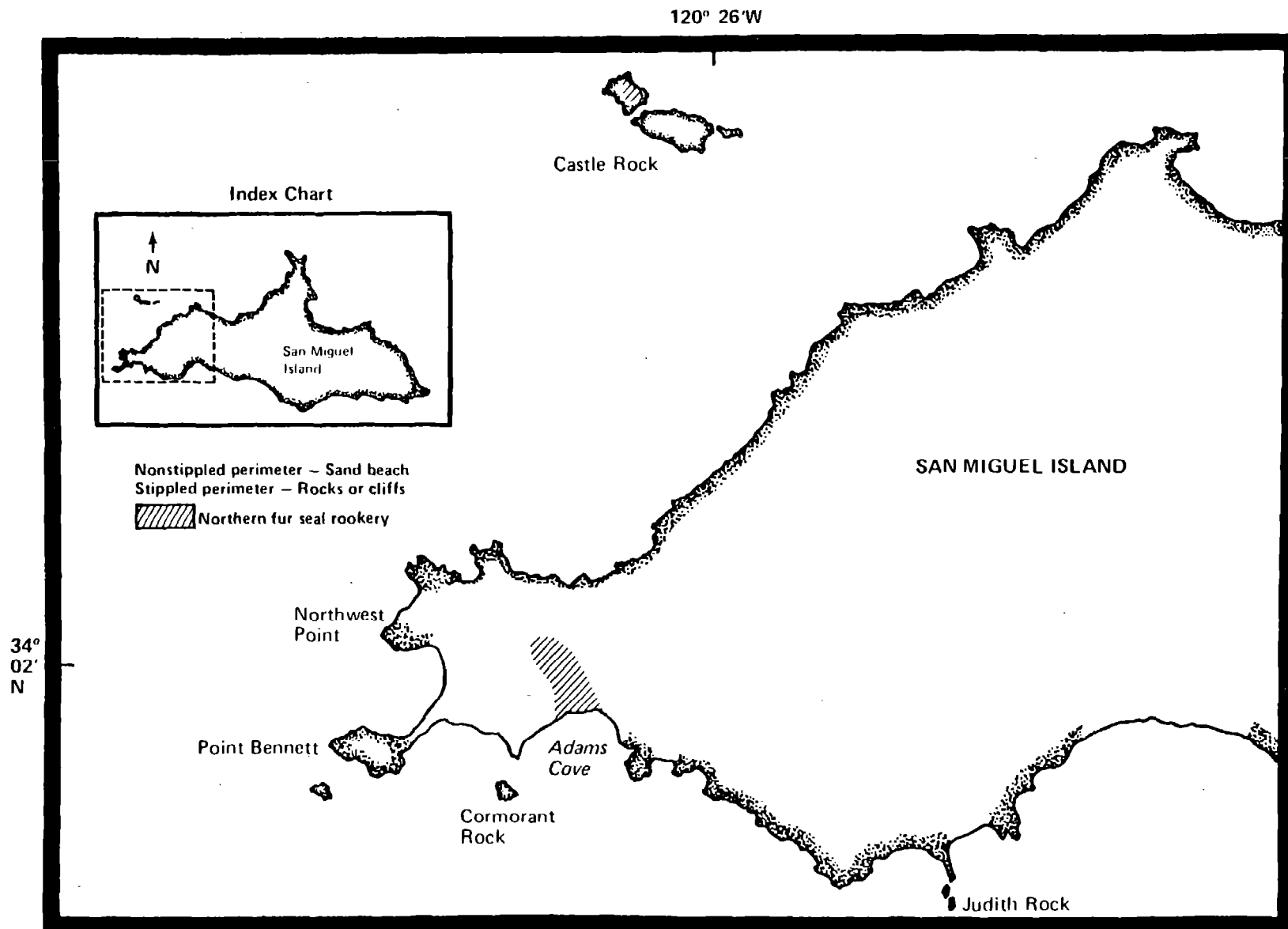


Figure 3.-- Location of northern fur seal breeding colonies, San Miguel Island, California.

In the same year, 329 males were also taken on St. George Island for subsistence. A moratorium on the commercial harvesting of seals on St. George Island was imposed beginning in 1973 to permit research on the population as it reverted to its natural state. Fur seals are not harvested on Bogoslof Island, Castle Rock, San Miguel Island, or Sea Lion Rock. However, some males from these rookeries may be subjected to a harvest mortality since young male seals occasionally haul out at some distance from their rookeries of birth. There are four extinct rookeries on St. Paul Island (Fig. 1) and one on St. George Island (Fig. 2).

Terms having special meanings in northern fur seal research are defined in the glossary, and Russian names given to some of the rookeries of the Pribilof Islands following their discovery by Russian fur hunters in 1786 are translated.

Tabular data for this report are presented as appendices. Appendix A is the data customarily presented concerning general studies, Appendix B is entanglement-related data, and Appendix C is a list of personnel involved in fur seal research in 1985.

POPULATION ASSESSMENT, PRIBILOF ISLANDS, ALASKA

by

Patrick Kozloff and Anne E. York

In accordance with provisions originally established under terms of the Interim Convention on Conservation of North Pacific Fur Seals, the National Marine Mammal Laboratory (NMML) continues to monitor the status of the fur seal herd on the Pribilof Islands through the collection of specific kinds of information on population size, age and sex composition, and natural mortality.

Population Parameters

Herd characteristics monitored on the Pribilof Islands in 1985 included the 1) age and sex composition of seals harvested for food on St. Paul Island, 2) number and sex of seals taken for food on St. George Island, 3) number of live adult males and pups, and 4) number of dead pups and older seals.

Age and Sex Composition of Seals Harvested

Males--Drives (roundups) were made from several hauling grounds on St. Paul Island from 17 July to 6 August. Male seals were selected without restrictions on size, although smaller animals (2-4 years old) were preferred. Seals were not harvested on Saturdays or Sundays, and those identified as females were rejected. The age composition of the males taken was determined from a 20% sample of maxillary canine teeth collected in each harvesting area (Appendix Tables A-1 and A-2). The sizes of the year classes of male seals harvested since 1971 are

listed in Table 1. The age composition of males harvested on St. Paul Island since 1976 is shown in Table 2.

On St. George Island, 329 subadult male seals of approximate ages 2-5 years were taken for food from the east hauling ground of North Rookery.

Females-In 1985, five young females up to 4 years of age were inadvertently taken during the subsistence harvest of males on St. Paul Island because of their similarities in size and in whisker (vibrissae) color to 3-year-old males. The maxillary canine teeth and reproductive organs of some of those taken were collected for age and reproductive studies.

Living Adult Male Seals Counted

In 1985, 4,372 harem and 3,363 idle adult male fur seals (bulls) were counted on St. Paul Island from 10 to 21 July (Appendix Tables A-3, A-4, and A-5). On St. George Island, 1,268 harem and 1,601 idle bulls were counted from 17 to 19 July (Appendix Tables A-4 and A-5). Figure 4 illustrates the relative location of the different classes of adult males on a typical fur seal rookery-hauling ground complex on the Pribilof Islands.

Dead Seals Older Than Pups Counted

The rookeries and adjacent beaches of St. George Island were surveyed for dead seals older than pups on 16 August and the count totaled 35 females and 17 males. Table 3 lists the number of these seals counted on the Pribilof Islands since 1965.

Table 1. --Harvest of male northern fur seals, by age group, St. Paul Island, Alaska, 1971-83 year classes.^a

| Year class | Number of seals | | | | Total harvested |
|-------------------|-----------------|---------|--------|-------|---------------------|
| | 2 | 3 | 4 | 5 | |
| 1971 | 577 | 14,652 | 10,768 | 722 | 26,719 |
| 1972 | 1,025 | 15,186 | 8,050 | 707 | 24,968 |
| 1973 | 1,642 | 13,397 | 9,421 | 598 | 25,058 |
| 1974 | 893 | 16,476 | 8,955 | 470 | 26,794 |
| 1975 | 1,783 | 13,752 | 7,918 | 725 | 24,178 |
| 1976 | 1,479 | 15,245 | 8,183 | 651 | 25,558 |
| 1977 | 2,051 | 13,157 | 6,714 | 511 | 22,433 |
| 1978 | 2,180 | 14,224 | 7,016 | 414 | 23,834 |
| 1979 | 2,284 | 15,123 | 6,644 | 304 | 24,355 |
| 1980 | 2,065 | 15,587 | 4,601 | 4 | 22,257 |
| 1981 ^b | 3,047 | 13,976 | 496 | - | 17,519 |
| 1982 ^b | 3,133 | 2,645 | - | - | 5,778 |
| 1983 ^b | 234 | - | - | - | 234 |
| Total | 22,393 | 163,420 | 78,766 | 5,106 | 269,685 |
| Mean | 1,723 | 13,618 | 7,161 | 511 | 24,615 ^c |

^a Includes only 2- to 5-year-olds taken during the harvest of male seals. In 1984, an upper limit of 22,000 fur seals was imposed in the harvest, and in 1985, the harvest was limited to a subsistence take for food.

^b Incomplete returns.

^c 1981, 1982, and 1983 year classes not included.




**Table 2.--Age classification of male northern fur seals harvested,
St. Paul Island, Alaska, 1976-85.**

| Year of harvest | Number of seals | | | | | | Total harvested |
|--------------------|-----------------|-------|--------|-------|-----|----|--------------------|
| | Age group | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| 1976 | 0 | 893 | 13,397 | 8,050 | 722 | 19 | 23,081 |
| 1977 | 0 | 1,783 | 16,476 | 9,421 | 707 | 9 | 28,396 |
| 1978 | 0 | 1,479 | 13,752 | 8,955 | 598 | 45 | 24,829 |
| 1979 | 0 | 2,051 | 15,245 | 7,918 | 470 | 18 | 25,702 |
| 1980 | 0 | 2,180 | 13,157 | 8,183 | 725 | 33 | 24,278 |
| 1981 | 0 | 2,284 | 14,224 | 6,714 | 651 | 19 | 23,892 |
| 1982 | 0 | 2,065 | 15,123 | 7,016 | 511 | 15 | 24,730 |
| 1983 | 16 | 3,047 | 15,587 | 6,644 | 414 | 20 | 25,728 |
| 1984 ^a | 0 | 3,133 | 13,976 | 4,601 | 304 | 20 | 22,034 |
| 1985 ^b | 0 | 234 | 2,645 | 496 | 4 | 0 | 3,379 |

^a An upper limit of 22,000 male fur seals was imposed in the harvest.

^b The harvest was limited to a subsistence take for food.

CLASSES OF BULLS

- 2. TERRITORIAL WITHOUT FEMALES 
- 3. TERRITORIAL WITH FEMALES 
- 5. HAULING GROUND 

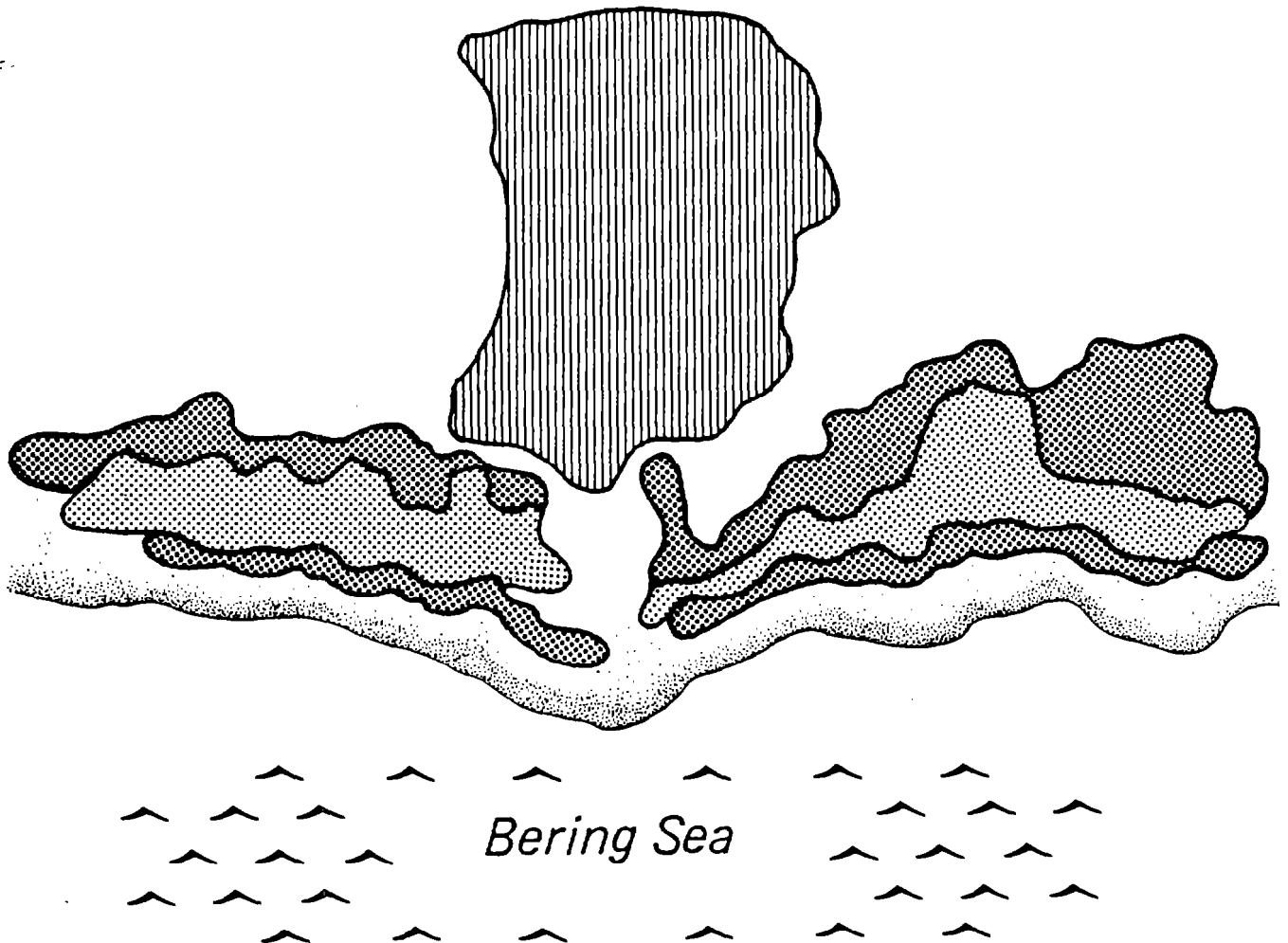


Figure 4.-- General composition of a typical fur seal rookery (see Glossary for classification of adult male fur seals).

Table 3. --Number of dead northern fur seals counted that were older than pups, Pribilof Islands, Alaska, 1965-85. A dash indicates no data.

| Year | St. Paul Island | | St. George Island | | Total | |
|------|-----------------|---------|-------------------|---------|-------|---------|
| | Males | Females | Males | Females | Males | Females |
| 1965 | 158 | - | - | - | 158 | - |
| 1966 | 181 | 172 | 41 | 55 | 222 | 227 |
| 1967 | 108 | 157 | 41 | 28 | 149 | 185 |
| 1968 | 98 | 141 | 33 | 22 | 131 | 163 |
| 1969 | 94 | 141 | 22 | 29 | 116 | 170 |
| 1970 | 52 | 124 | 4 | 53 | 56 | 177 |
| 1971 | 39 | 91 | 5 | 37 | 44 | 128 |
| 1972 | 46 | 111 | 22 | 30 | 68 | 141 |
| 1973 | 61 | 65 | 7 | 30 | 68 | 95 |
| 1974 | 33 | 30 | 4 | 15 | 37 | 45 |
| 1975 | 92 | 99 | - | - | 92 | 99 |
| 1976 | 46 | 64 | - | - | 46 | 64 |
| 1977 | 60 | 69 | - | - | 60 | 69 |
| 1978 | 57 | 87 | - | - | 57 | 87 |
| 1979 | 56 | 66 | -* | -* | 56 | 66 |
| 1980 | 102 | 117 | 14 | 65 | 116 | 182 |
| 1981 | 44 | 83 | 12 | 61 | 56 | 144 |
| 1982 | 47 | 117 | - | - | 47 | 117 |
| 1983 | 57 | 66 | - | - | 57 | 66 |
| 1984 | 66 | 72 | - | - | 66 | 72 |
| 1985 | 7 | 39 | 17 | 35 | 17 | 35 |

* A total of 70 dead fur seals of both sexes that were older than pups were counted on the rookeries of St. George Island.

Dead Pups Counted

In 1985, 5,266 dead fur seal pups were counted on all rookeries of St. Paul Island from 22 August to 5 September (Appendix Table A-6). On 16 August, dead pup counts on St. George Island totaled 806 animals (Appendix Table A-6). The number of dead pups counted on both islands since 1976 are given Appendix Table A-7.

Number of Pups Born in 1985

St. Paul Island--The total number of pups alive at the time of shearing and its standard error have been estimated using the methods from York and Kozloff (1987). From the mean estimate from both sampling periods (Table 4) and the mid-July count of harem males (Appendix Table A-4), we computed the ratio of live pups to bulls on the sample rookeries. Following the procedure in the 1980 report of Fur Seal Investigations (Roppel et al. 1981), we estimated total numbers of pups born by multiplying the estimated ratio by total numbers of breeding males on all rookeries and adding the count of dead pups as follows:

| <u>Rookery</u> | <u>Pup count</u> | <u>Harem bulls</u> | <u>Ratio pups:bulls</u> | <u>r</u> | <u>r*</u> |
|---------------------|----------------------|------------------------|-----------------------------|----------|-----------|
| Gorbatch | 12,884 | 320 | 40.26 | 40.30 | 40.25 |
| Lukanin | 3,742 | 106 | 35.30 | 40.60 | 38.46 |
| Kitovi Amphitheater | 890 | 18 | 49.44 | 40.20 | 40.83 |
| Morjovi | 10,473 | 300 | 34.91 | 41.34 | 33.99 |
| Reef | 20,586 | 474 | 43.43 | 39.20 | 46.84 |
| Polovina Cliffs | 16,683 | 376 | 44.37 | 39.24 | 46.59 |
| Kitovi | <u>8,758</u> | <u>243</u> | <u>36.04</u> | 40.94 | 36.40 |
| Total | 74,016 | 1,837 | 40.29 | | |

Table 4.--Estimated number of northern fur seal pups in 1985 at times of shearing and birth on seven rookeries of St. Paul Island, Alaska. Pups were sheared 29 July and 3-9 August; sampling periods 1 and 2 were 22-24 and 26-28 August, respectively.

| Item | Rookery | | | | | | | Total |
|---------------------------------------|----------|---------|------------------------|-----------------------|--------|--------------------|--------|--------|
| | Gorbatch | Lukanin | Kitovi Amphitheater | Morjovia ^a | Reef | Polovina Cliffs | Kitovi | |
| No. pups sheared | 1,236 | 384 | 64 | 1,212 | 1,938 | 1,593 | 878 | 7,305 |
| No. 25-pup samples | | | | | | | | |
| Period 1 | 80 | 41 | 12 | 74 | 124 | 149 | 87 | - |
| Period 2 | 92 | 32 | 13 | 92 | 191 | 158 | 73 | - |
| No. sheared pups counted | | | | | | | | |
| Period 1 | 200 | 111 | 21 | 231 | 277 | 377 | 223 | - |
| Period 2 | 212 | 78 | 24 | 248 | 475 | 357 | 179 | - |
| Total no. pups counted ^b | | | | | | | | |
| Period 1 | 2,000 | 1,025 | 300 | 1,850 | 3,100 | 3,725 | 2,175 | - |
| Period 2 | 2,300 | 800 | 325 | 2,300 | 4,775 | 3,950 | 1,825 | - |
| Estimated no. pups alive ^c | | | | | | | | |
| Period 1 sampling | 12,360 | 3,546 | 914 | 9,706 | 21,689 | 15,740 | 8,563 | 72,518 |
| Period 2 sampling | 13,409 | 3,938 | 867 | 11,240 | 19,482 | 17,626 | 8,952 | 75,514 |
| Mean, both period | 12,884 | 3,742 | 890 | 10,473 | 20,586 | 16,683 | 8,758 | 74,016 |
| No. dead pups counted | 371 | 149 | 9 | 244 | 624 | 367 | 202 | 1,966 |
| Estimated no. pups born ^d | 13,255 | 3,891 | 899 | 10,717 | 21,210 | 17,050 | 8,960 | 75,982 |

a Does not include second point south of Sea Lion Neck.

b Number of samples X 25 = total number of sheared and unsheared pups.

c Estimated from $N = MC/R$. (M = no. pups sheared, C = total no. pups counted, and R = no. sheared pups counted).

d Sum of dead pups counted and mean estimate of pups alive at times of sampling.

where r is the ratio of pups to bulls on all but the particular sample rookery, and

$$r^* = 7r - 6\bar{r} \text{ where } r = \frac{\text{total pups}}{\text{breeding males}} = \frac{74,016}{1,837} = 40.29$$

The estimate of the ratio of pups to bulls (R) is

$$\hat{R} = 1/7 \sum_{j=1}^7 r^*(j) = 40.48,$$

$$\text{and } \hat{\text{Var}}(\hat{R}) = \sum = \frac{r^*(j)^2 - 7\hat{R}^2}{42} = 3.347 \text{ and } \text{SE}(R) = 1.829.$$

Thus, an approximate 95% confidence interval for the ratio of live pups to harem males is 40.48 ± 4.32 .

The total number of harem males counted on all rookeries of St. Paul Island is 4,372 (Appendix Table A-4).

Thus, the estimated number of pups alive at the time of shearing is $172,922 \pm 18,887$. The number of dead pups counted was 5,266. Therefore, the estimate of number of pups born is $182,258 \pm 18,887$.

St. George Island - The number of pups born in 1985 is given in Table 5 and is based on shearing-sampling procedures developed in the 1960s.

Mark Recoveries

During the 1985 field season on Bogoslof and St. Paul Islands 19 seals marked by the Soviet Union were sighted. Appendix Table A-8 lists the number of Soviet tags observed by the United States in 1985.

Table 5.--Estimated number of northern fur seal pups in 1985 at times of shearing and birth on St. George Island, Alaska. Pups were sheared 12-15 August and sampled for marked to unmarked ratios 16 August.

| Item | Rookery | | | | | North | Total |
|---------------------------------------|---------|---------|-------------|-----------|---------------|--------|--------|
| | South | Zapadni | East Cliffs | East Reef | Staraya Artil | | |
| No. pups sheared | 586 | 448 | 464 | 223 | 314 | 1,113 | 3,148 |
| No. 25-pup samples | 34 | 31 | 36 | 13 | 31 | 88 | - |
| No. sheared pups counted | 108 | 73 | 128 | 51 | 83 | 221 | - |
| Total no. pups counted ^a | 850 | 775 | 900 | 325 | 775 | 2,200 | - |
| Estimated no. pups alive ^b | 4,612 | 4,756 | 3,262 | 1,421 | 2,932 | 11,080 | 28,063 |
| No. dead pups counted | 128 | 134 | 106 | 22 | 99 | 317 | 806 |
| Estimated no. pups born ^c | 4,740 | 4,890 | 3,368 | 1,443 | 3,031 | 11,397 | 28,869 |

^a Number of samples X 25 = total number of sheared and unsheared pups.

^b Estimated for $N = MC/R$ (M = no. pups sheared, C = total no. pups counted, and R = no. sheared pups counted).

^c Sum of dead pups counted and estimate of pups alive at times of sampling.

HISTORICAL CHANGES IN THE MEAN WEIGHT OF
MAXILLARY CANINE TEETH FROM MALES TAKEN IN
THE COMMERCIAL HARVEST, ST. PAUL ISLAND, ALASKA

by

Jason Baker

Evidence of density-dependent responses in body size of the northern fur seal (Callorhinus ursinus) was first presented by Scheffer (1955) who observed a decrease in age-specific mean body size in a population which was rapidly increasing. Recently, the converse effect was observed by Fowler (1984) who reviewed information indicating that while the population of northern fur seals has been decreasing since the late 1950s, the mean body size has been concomitantly increasing. An analysis of tooth weights presented by Hartley (1982) showed that tooth weights were highly correlated with body length, and could, therefore, be used as an indicator of change in mean body size. The analysis of the tooth data by Hartley (1982) and Fowler (1984) were, in fact, in agreement with the results of other methods which showed a density-dependent increase in mean body size. However, these preliminary analyses of tooth weights were based on relatively small samples. The purpose of this report is to examine density dependence in fur seal body size by extending the tooth weight study to include a larger sample size.

Materials and Methods

The teeth used for this study were taken from 3- and 4-year-old male northern fur seals during the annual harvest on St. Paul Island. Upper canines were extracted at random from approximately 20% of the harvest. The teeth were treated and cleaned on the island, then sent to Seattle, Washington, where they were stored. Samples of teeth were weighed from the years 1948-84, excluding 1950 and 1951, for which no samples were available.

A total of 21,939 teeth were weighed; 14,245 were from 3-year-olds and 7,694 were from 4-year-olds (Table 6). Early in the study, all teeth available for a given year were weighed. However, it became evident that it would suffice, statistically, to subsample only a portion of the teeth from years with large numbers available. The subsamples selected reflect the proportion of 3- to 4-year-olds harvested as well as the percentages harvested by rookery in each year. Although distributing the subsamples evenly over age class and rookery may have been more desirable., it was impossible due to the uneven distributions of ages and rookeries among the teeth available. (See Table 6 for a summary of the sample sizes.)

The teeth were weighed individually on a digital scale accurate to 0.01 g. The scale was calibrated at the beginning of each weighing period.

The possibility of the teeth drying and thus losing weight over time was a concern during this study. If drying were to occur, it could account for the increase in mean tooth weight over time. There is also another complication which could occur in this regard. One would expect the drying

Table 6.--Number of northern fur seal teeth weighed by year, St. Paul Island, Alaska, 1948-84.

| Year | 3-year-olds | | | 4-year-olds | | |
|-----------------|------------------|----------------|-----------------|------------------|----------------|-----------------|
| | Number available | Number weighed | Percent weighed | Number available | Number weighed | Percent weighed |
| 1948 | 107 | 107 | 100 | 44 | 44 | 100 |
| 1949 | 31 | 31 | 100 | 15 | 15 | 100 |
| 1952 | 376 | 376 | 100 | 196 | 196 | 100 |
| 1953 | 393 | 393 | 100 | 204 | 204 | 100 |
| 1954 | - * | 287 | - | - * | 251 | - |
| 1955 | - * | 318 | - | - * | 293 | - |
| 1956 | 87 | 87 | 100 | 85 | 85 | 100 |
| 1957 | 43 | 43 | 100 | 29 | 29 | 100 |
| 1958 | 390 | 390 | 100 | 66 | 66 | 100 |
| 1959 | 35 | 35 | 100 | 33 | 33 | 100 |
| 1960 | 709 | 709 | 100 | 100 | 100 | 100 |
| 1961 | 838 | 838 | 100 | 383 | 383 | 100 |
| 1962 | 87 | 87 | 100 | 72 | 72 | 100 |
| 1963 | 4 | 4 | 100 | 27 | 27 | 100 |
| 1964 | 239 | 239 | 100 | 96 | 96 | 100 |
| 1965 | 174 | 174 | 100 | 174 | 174 | 100 |
| 1966 | 286 | 286 | 100 | 161 | 161 | 100 |
| 1967 | 295 | 295 | 100 | 137 | 137 | 100 |
| 1968 | 675 | 241 | 36 | 645 | 123 | 19 |
| 1969 | 315 | 315 | 100 | 112 | 112 | 100 |
| 1970 | 619 | 170 | 27 | 318 | 87 | 27 |
| 1971 | 2,310 | 86 | 4 | 2,195 | 142 | 6 |
| 1972 | 2,353 | 623 | 26 | 2,920 | 652 | 22 |
| 1973 | 3,156 | 705 | 22 | 2,035 | 483 | 24 |
| 1974 | 2,335 | 653 | 28 | 2,696 | 657 | 24 |
| 1975 | 2,523 | 137 | 5 | 1,847 | 100 | 5 |
| 1976 | 1,564 | 289 | 18 | 1,081 | 296 | 27 |
| 1977 | 3,021 | 740 | 24 | 1,928 | 505 | 26 |
| 1978 | 2,524 | 634 | 25 | 1,754 | 448 | 26 |
| 1979 | 3,449 | 171 | 5 | 1,757 | 89 | 5 |
| 1980 | 347 | 347 | 100 | 30 | 30 | 100 |
| 1981 | 532 | 532 | 100 | 309 | 309 | 100 |
| 1982 | 143 | 143 | 100 | 65 | 65 | 100 |
| 1983 | 2,083 | 2,083 | 100 | 677 | 677 | 100 |
| 1984 | <u>1,677</u> | <u>1,677</u> | 100 | <u>553</u> | <u>553</u> | 100 |
| Total | 33,720 | 14,245 | | 22,744 | 7,694 | |
| Average percent | | | 42 | | | 34 |

* Number by age not available. There were a total of 1,200 teeth from all age classes in 1954; 45% of these were weighed (24% three-year-olds and 21% four-year-olds). The respective figures for 1955 are 1,916 teeth, of which 32% were weighed (17%).

process to be a response to a drop in the relative humidity of the environment in which the teeth are stored. Such a response could have occurred, for example, due to the move of the National Marine Mammal Laboratory (NMML) to a new building in August of 1984. Some teeth were weighed where they were originally stored, while others were weighed in the new laboratory. In addition, teeth from different years were weighed throughout 1984-85, so that varying seasonal relative humidity could possibly have affected the tooth weights.

In order to address these concerns, an experiment using teeth from the 1984 fur seal harvest was carried out to determine whether or not drying could have significantly affected the results of the study. All the teeth were individually identified and weighed immediately upon being received from St. Paul Island. Then, two subsamples were weighed several times at various dates and locations. One group was kept in the original storage area, while the other was moved to the new laboratory.

If the teeth were to lose weight through drying in the original storage area, it was expected that the decrease would be rapid at first and then level off. However, with the group of 1984 teeth which were stored there and reweighed, this did not occur. Upon the second weighing, conducted after 2 weeks, the teeth had actually gained an average of 0.02 g. Subsequently, their weights remained stable for 8 months. These teeth seemed to have first absorbed some weight, presumably water, then having reached an equilibrium with the new environment, remained stable. This indicates that the weights of the teeth in the original storage area probably have not changed over the years unless a change occurs after prolonged storage.

Next, there was the problem of the samples being weighed in two locations, the storage area and the new laboratory. The new laboratory tended to be less humid than the storage area, so it seemed likely that the teeth would lose weight there. The second subgroup of 1984 teeth was used to investigate this problem. These teeth were moved alternately between the storage area and the new laboratory and reweighed a number of times. It was observed that changes of 0.01 g (tooth weight) could occur overnight. When the 1984 subgroup was left in the new laboratory, the teeth continued to lose weight for 6 months (October 1984 to April 1985). After another 5 months, the teeth gained weight slightly. This weight gain was somewhat perplexing, but may also be explainable as a result of an unmeasured increase in the new laboratory's humidity over the last 5 months of the study (April to September 1985).

Thus, it appears that tooth weight undergoes some change in response to environmental conditions. However, it is reassuring that the magnitude of the changes are small. The teeth in the subgroup kept in the new laboratory lost only 1.8% of their original weight over a period of 70 days. Teeth from other years, excluding the 1984 subgroup, were kept in the new laboratory for no more than 20 days while being weighed. Compared with the observed differences in mean tooth weights between the early 1960s and 1984 (10%), the effects of drying do not appear substantial.

Results

Before tooth weight could be used in an analysis of density-dependent changes in body size, the relationship between tooth weight and body length had to be established. Figure 5 is a plot of tooth weight versus body length of 1,043 fur seals between 1 and 6 years old, which were harvested and measured in 1983. The resulting relationship is significant at the 1.0% level ($r = 0.73$, $p < 0.01$), using major axis regression analysis (Ricker 1984) to account for each variable exhibiting its own variance.

Given this highly correlated relationship, mean tooth weight may be viewed as an index of mean body size. Figures 6 and 7, which are the result of calculating running means of three, weighted by sample size, indicate that mean tooth weights have been increasing since the early 1960s. During this same period, the overall fur seal population has declined. In order to examine the relationship of greater importance in terms of density dependence, Figures 8 and 9 show mean tooth weights versus the total number of fur seal pups born in a given year, the latter parameter being the best available index of population level. These graphs, however, involve a time lag. For example, Figure 8 plots the mean tooth weight of 3-year-olds against the number of pups born 3 years earlier. Considering what the parameters of these graphs represent, it appears that as the population decreases, the mean tooth weight and the mean body size of the animals increases.

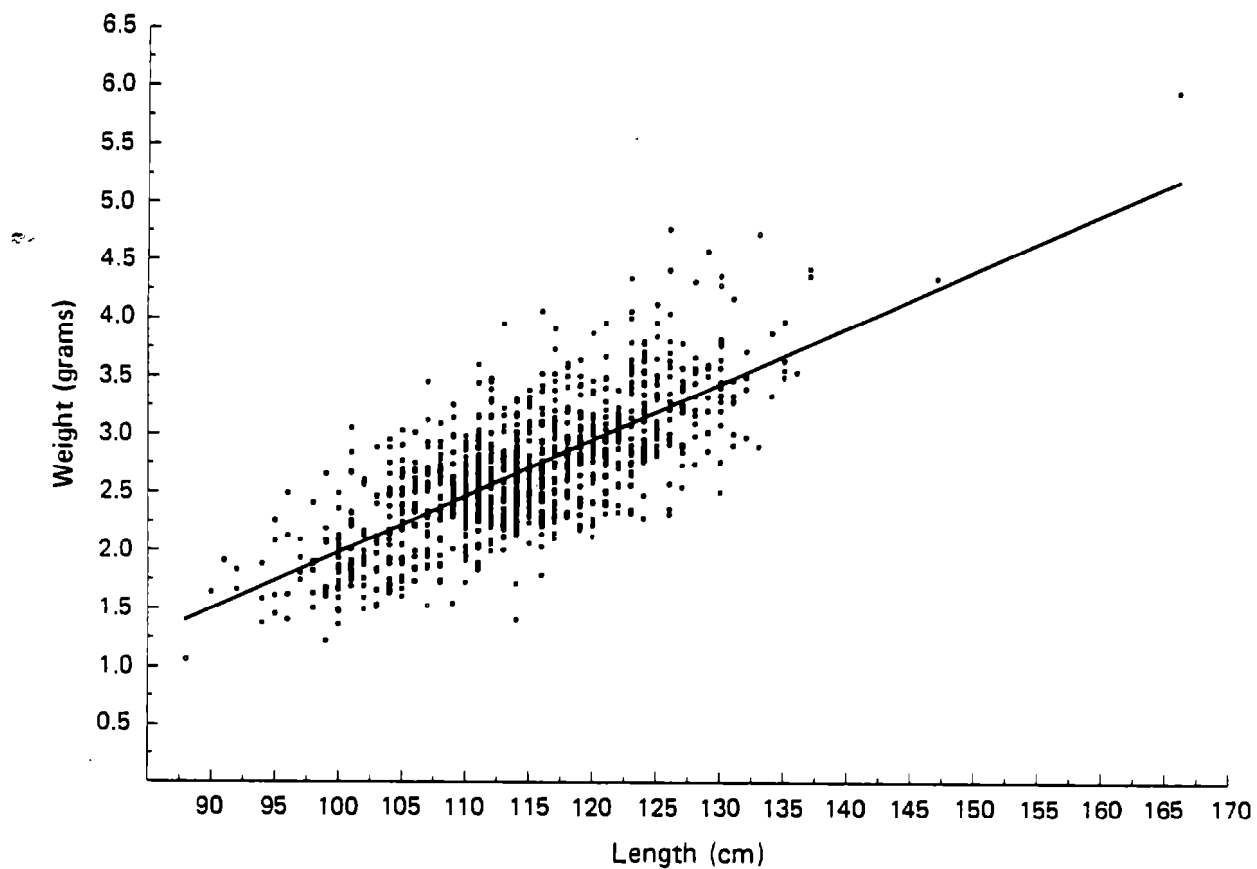


Figure 5.--Tooth weight versus body length of 1,043 male fur seals (1-6 years of age) which were harvested and measured' on St. Paul Island, Alaska, 1983.

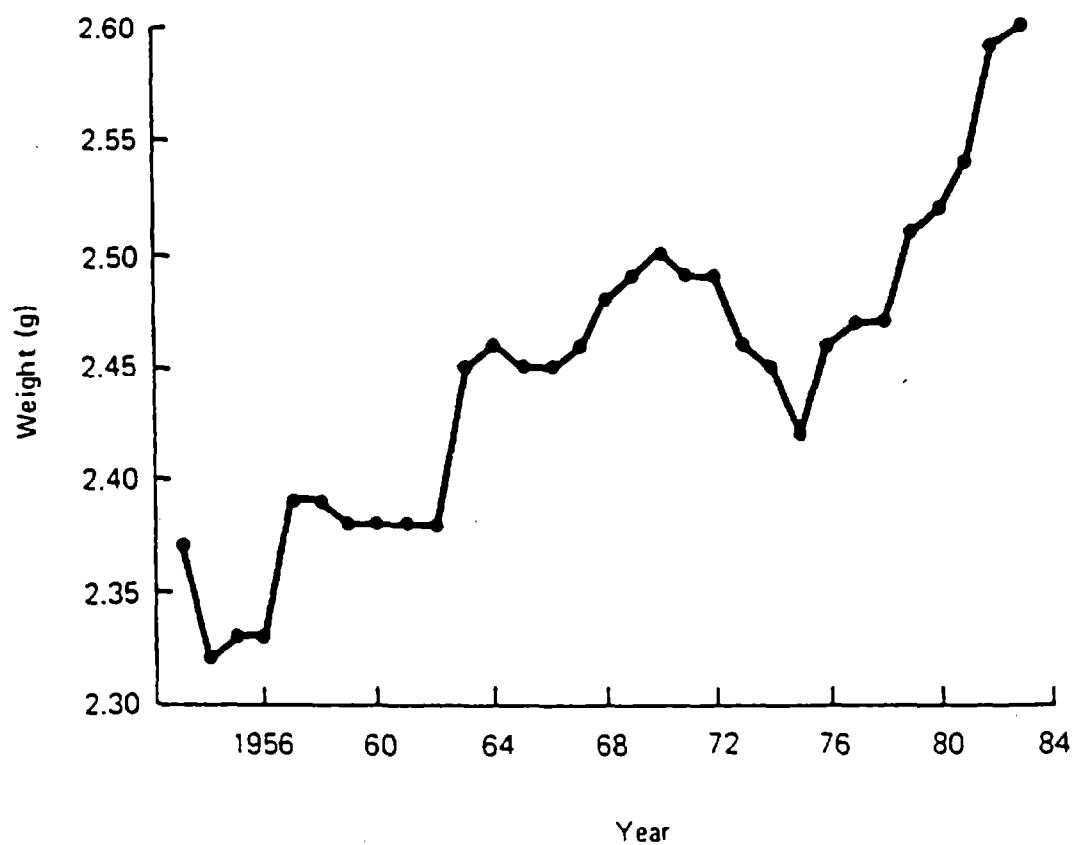


Figure 6.-- Three-year running means of the tooth weight of 3-year-old males plotted in the year of sampling, St. Paul Island, Alaska.

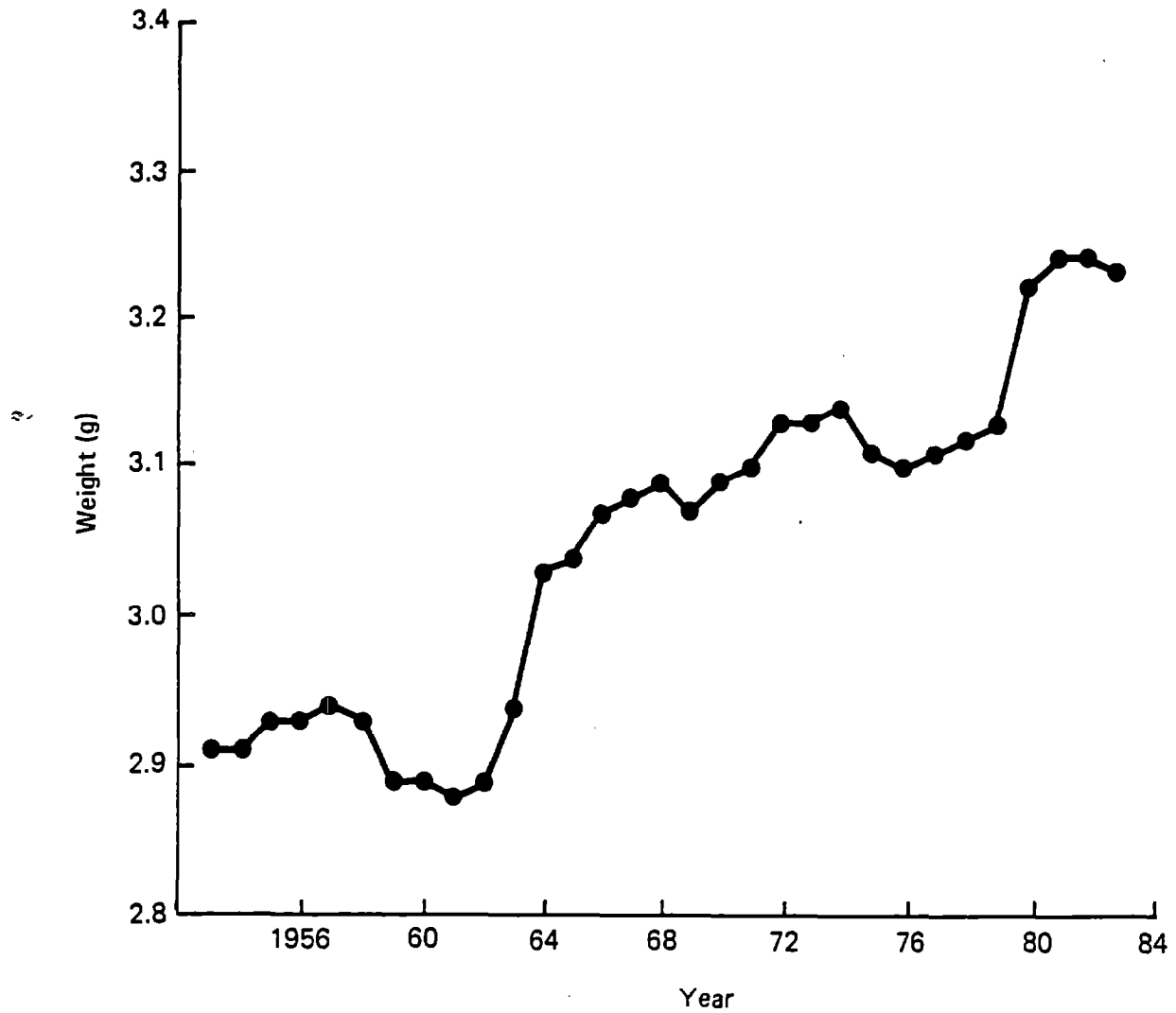


Figure 7.--Three-year running means of the tooth weight of 4-year-old males plotted in the year of sampling, St. Paul Island, Alaska.

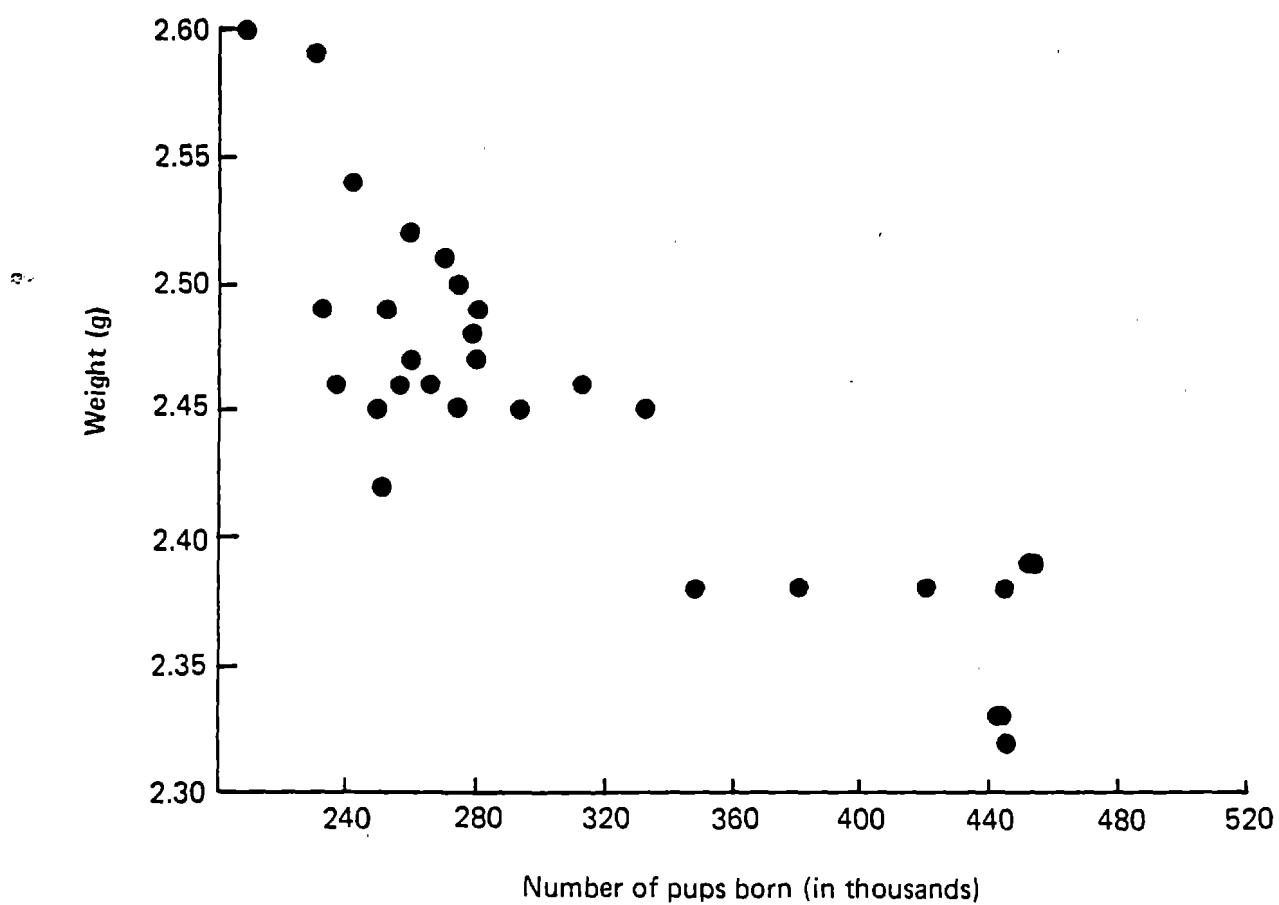


Figure 8.--Number of pups born in a given year and their mean tooth weights as age-3 cohorts, St. Paul Island, Alaska.

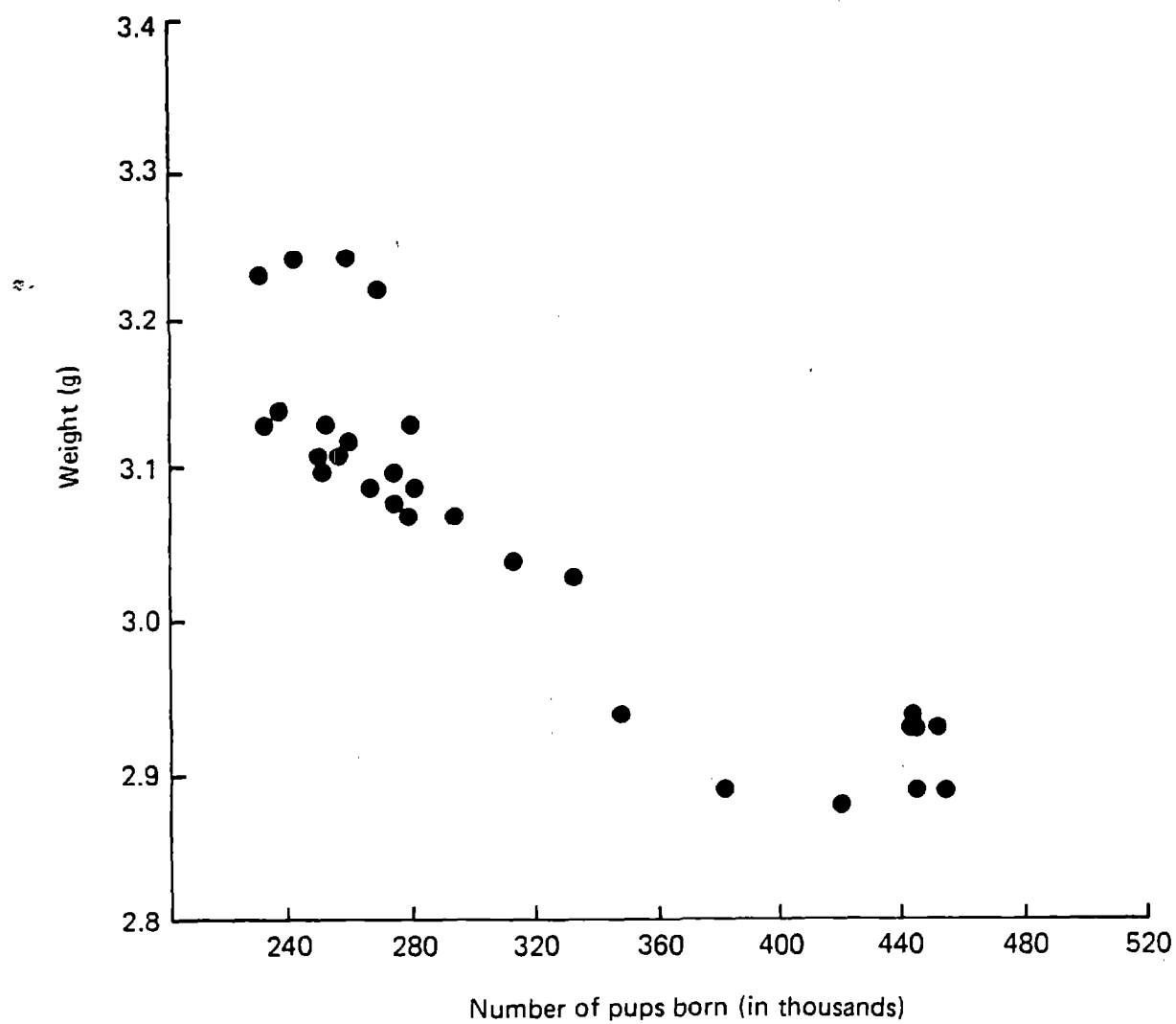


Figure 9.-- Number of pups born in a given year and their mean tooth weights at age 4 years, St. Paul Island, Alaska.

The results of this study are, to a great extent, in agreement with the tooth studies presented in Fowler (1984) as based on Hartley (1982). This analysis, involving a larger sample size than that of the previous analysis, has reinforced the evidence that body size is density dependent. The implication of this in the context of the present situation is that the fur seal population is below its carrying capacity.

The possibility of a decreasing abundance and availability of prey-consumed by northern fur seals being responsible for their population decline seems unlikely. For if this were the case, the carrying capacity would in turn be lowered, leaving the fur seals on roughly the same nutritional plane. Their increased body size, however, suggests a lower population level with a higher abundance of food per individual. Therefore, it seems that other external factors, which do not affect carrying capacity, are responsible for the population decline. Although the results of this study and other density-dependent responses observed within the fur seal population do not indicate that the decline is the result of insufficient food resources, it must be noted that this particular study involved only young males. Fowler (1985) has suggested that entanglement in fishing debris is one source of the mortality for the fur seal population and its lack of recovery. Other limiting factors under consideration are disease, toxic substances, illegal or incidental taking at sea, and increased predation.

DURATION OF FEEDING TRIPS AND AGE-RELATED REPRODUCTIVE
SUCCESS OF LACTATING FEMALES, ST. PAUL ISLAND, ALASKA

by

Michael E. Goebel

Preliminary results of an ongoing study of female diving patterns were documented in the 1984 report of fur seal investigations (Gentry et al. 1986). It was reported that females showing a deep diving pattern were large, older females and that small, young females tended to be shallow divers. The trends suggested that size or age may be important in determining which dive pattern a lactating female might exhibit. If experience influences diving patterns, a difference by age may be seen in other behaviors. In 1985, the effect of age and experience on feeding cycles of lactating females and survival of their pups was examined at Kitovi Rookery on St. Paul Island.

Methods

It was not possible to obtain known-age females. However, past data have shown that older females tend to arrive earlier in the season than do younger ones, thereby allowing an observer to qualitatively sample for older or younger females (Wilke 1953; Bigg 1986). Vibrissae color also indicates relative age (most females through age 3 years have black vibrissae; 4- and 5-year-olds generally have black and white; and females 6 and older have white vibrissae) (Scheffer 1962; Abeggelen et al. 1958). Therefore, by sampling only white-vibrissaed females before the peak of pupping and black-vibrissaed females thereafter, it was possible to obtain qualitatively different age samples.

A total of 47 females with pups were captured and tagged. All but one female were perinatal when captured; the exception, a mixed, mostly-white vibrissaed female, was captured on her second visit to shore. Each female was also marked by clipping guard hair on both shoulders to expose the lighter underfur which was then bleached, leaving a highly visible mark. All pups of the earlier-arriving females (20) were captured, marked and tagged between 29 June and 1 July. Only 13 pups of the late-arriving group of 27 females were captured and marked from 17 July to 2 August. Of the late-arriving group, 8 females were categorized as black vibrissae, 9 were categorized as mixed, mostly white vibrissae, and 10 were categorized as mixed, mostly black vibrissae.

Attendance patterns were recorded from mid-June until 24 August and again from 5 October until 31 October. Any time a female was observed on shore, it was recorded as present for that entire day; any day she was not seen was recorded as a day at sea (Gentry and Holt 1986). Observations in July and August were made 7-8 hours per day, and the rookery was scanned every 5 minutes. In October, observations were made at least twice a day for at least 1 hour each time, once shortly after dawn and again in the evening.

Analysis of variance (ANOVA) was used in comparisons of duration of feeding trips for the two groups of females. Females which had lost their pups by October were excluded from some analyses.

Results

The major results of this study can be divided into two categories: duration of feeding trips and reproductive success. Survival of pups to weaning was used as a measure of reproductive success.

Duration of Feeding Trips

The mean length of the first trip for early-arriving females was 3.55 days (20 trips, SD = 1.39) and for late-arriving females it was 6.00 days (19 trips, SD = 1.15). Early-arriving females, however, made as many as eight trips to sea ($x = 6.65$) by the time data collection was terminated on 25 August, while late-arriving females made as many as four trips ($x = 3.05$). Only the first 3 trips to sea were used in initial analyses to eliminate bias toward trips of early-arriving females. Females, which lost their pups before data collection was terminated, were not included in the analyses.

The difference in mean trip length between the two groups was significant ($p = 0.999$ ANOVA). The mean trip length of early-arriving females was 4.47 days (59 trips, SD = 1.60), compared to a mean of 6.70 days for late-arriving females (56 trips, SD = 2.34). When all females that had lost their pups by October were removed from the analysis, the significant difference remained ($p = 0.999$ ANOVA).

This difference, however, was not seen in trips recorded in October. Most females in each group had at least two trips; four from each group had only one trip. The total number of early- and late-arriving females observed with pups in October was 18 and 17, respectively. The mean length of trips to sea in October for females pupping early was 7.67 (SD = 1.32); and for late-pupping females, 7.93 (SD = 1.77).

Attendance patterns of the younger-aged sample differed in one other respect. Individual females from the early-arriving group tended to make either short or long trips. Females which tended toward short trips always had short trips, while those with long trips always had long trips (with both types, trips increased in length as the season progressed). Young females, however, exhibited much more variability in trip length within individuals; (that is, they would frequently make a short trip followed by a long one or vice versa. This may be a reflection of a lack of experience in foraging.

Reproductive Success

The difference in reproductive success between old and young females was significant ($p = 0.985$ Chi-square). By October, just prior to weaning, 34.6% (9/26) of the late-pupping black- and mixed-vibrissaed females had lost their pups. In contrast, only 7.4% (2/27) of early-pupping, white-vibrissaed females had lost pups.

The nature of this mortality is of interest both for when it occurred and to which females. Of the two white-vibrissaed females which lost pups, one was never observed in October. It was, therefore, not possible to determine whether the pup died and the female ceased returning as a result, or whether she failed to return for other reasons, resulting in the death of the pup. The other female lost her pup to an unknown cause after five trips to sea. This female had made regular trips up until the time the apparently healthy pup was no longer seen. The female actively searched for her pup on two protracted subsequent visits. Mortality in both cases occurred long after birth and did not appear related to bonding or behavior of the female or pup.

Late-pupping females that had lost their pups were predominantly younger black-vibrissaed and mixed, but mostly black-vibrissaed animals. Of these nine females three had all black vibrissae, five were mixed, mostly black, and only one was mixed, mostly white. Of these females, 78.0% lost their pups in the first 3 weeks after parturition.

The younger females differed behaviorally from the older females in respects other than their attendance patterns. These differences apparently affect their reproductive success. For example, two of these females were intercepted by peripheral males upon arrival at the rookery and appeared unable to escape to more desirable pupping areas. These females repeatedly attempted to escape but eventually gave birth in the intertidal zone. Within groups of females, the younger females often had more difficulty in reuniting with their pups, once separated. They often appeared intimidated and submissive in their interactions with the older, larger females. These same behaviors were also apparent when they were defending their pups from nearby females. Some of this mortality can also be attributed to problems with mother-pup bonding during the period immediately following parturition. In one case, a female was observed giving birth but then failed to call to the pup in the usual manner. Later, this female allowed her pup to suckle, but when separated, she turned in the direction of her calling pup but did not otherwise respond. Some of these differences will be quantified in future studies.

Discussion

Attendance patterns in Otariids, as in other species, have often been suggested as possible indicators of environmental quality and resource availability (Antonelis and DeLong 1985; Chapman 1961; Gentry and Kooyman 1986; Loughlin et al. 1987). The results of this study indicate that care should be taken to avoid bias when sampling females for attendance patterns. Sampling is often biased toward early-arriving animals. It also appears that experience and age play important roles in determining reproductive success. Diving records of young females may also provide further insight into the role of experience in foraging behavior. Four such records from young females with vibrissae of mixed color were collected this year, the results of which will be reported in a future publication.

FUR SEAL ENTANGLEMENT STUDIES: JUVENILE MALES
AND NEWLY-WEANED PUPS, ST. PAUL ISLAND, ALASKA

by

John L. Bengtson, Charles W. Fowler, Hiroshi Kajimura,
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Over the past several decades, northern fur seals on the Pribilof Islands have been observed entangled in various types of marine debris. The incidence of entangled fur seals observed ashore increased from the mid-1960s to the early 1970s. Estimated entanglement rates of harvested juvenile males were approximately 0.4% from the early 1970s through 1984, the year of the most recent commercial harvest.

From 1967 to 1984, the entanglement rate of juvenile males was estimated annually from the commercial harvest. However, with the shift to subsistence harvest in 1985, different methods were used to evaluate the status and impact of entanglement on various portions of the fur seal population. To investigate the potential impact of entanglement on young age classes, two new research programs were initiated in 1985 on St. Paul Island: 1) entanglement research roundups (drives) of juvenile males on haul-out areas, and 2) experimental entanglement studies on captive, nearly-weaned pups.

Entanglement Research Roundups

The three principal objectives for conducting entanglement research roundups were: 1) to estimate the entanglement rate of juvenile males on haul-out areas, 2) to estimate the relative mortality rate of juvenile males entangled in debris, and 3) to assess the fate and impact

of debris on seals that were tagged in previous years. The roundups were conducted similarly to the method used for rounding-up seals during harvest operations. However, once the seals on a certain haul-out area had been prevented from escaping to the sea, they were not driven further. Instead, they were allowed to return to sea in small groups or as a "stream" of individuals, allowing observers to count the number of seals of harvestable size, and examine individuals for tags, debris, or net marks. This procedure was very efficient for handling and checking large numbers of seals in a relatively short period of time, and was less stressful to the seals because they were not driven long distances or held for prolonged periods.

From 8 July to 10 August 1985, 63 entanglement research roundups were conducted; over 22,000 seals were examined during these roundups (Table 7). A total of 98 seals were observed entangled in debris during this project. Of these, 76 were tagged for the first time in 1985 (Table 8). Some tagged individuals were resighted during subsequent roundups (Table 9). An additional 22 had been tagged in previous seasons (Table 10). All entangled seals of harvestable size were restrained, flipper-tagged with orange "Allflex"^{1/} tags (if not previously tagged), and inspected for the type of debris and potential wounds caused by the debris (Table 8). When possible, a sample of the debris was taken for identification of net webbing gear. Seals with netmarks (aberrations of the fur indicating former entanglement from

^{1/} Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Table 7.--Summary of northern fur seal males sampled in 1985 during entanglement studies at St. Paul Island, Alaska. A dash indicates no data.

| Date | Location | Sample | Number ^a | Number of tags applied | | Not tagged | |
|---------|-------------|--------|---------------------|---------------------------|-----------------|----------------|---------|
| | | | | Debris | Control | Debris | Netmark |
| 8 Jul. | Polovina | D | 432 | 0 | 0 | 0 | 0 |
| 9 Jul. | Gorbatch | D | 367 | 3 | 8 | 0 | 0 |
| 10 Jul. | Tolstoi | D | 280 | 1 | 4 | 1 ^b | 0 |
| 11 Jul. | Zapadni | D | 558 | 4 | 10 ^c | 0 | 4 |
| 12 Jul. | NE Point E | D | 303 | 2 | 6 | 0 | 0 |
| 15 Jul. | Zapadni | D | 257 | 1 | 2 ^d | 0 | 1 |
| 16 Jul. | Gorbatch | D | 422 | 3 | 6 | 0 | 0 |
| 17 Jul. | NE Point E | H | 326 | 0 | 0 | 0 | 0 |
| 17 Jul. | NE Point W | He | 357 | 1 | 2 | 0 | 2 |
| 18 Jul. | Polovina | H | 411 | 1 | 2 | 0 | 2 |
| 19 Jul. | Little Zap. | H | 499 | 1 | 4 | 1 ^h | 0 |
| 20 Jul. | Zap. Reef | D | - ^f | 1 | 2 | 0 | - |
| 20 Jul. | Tolstoi | D | 860 | 2 | 4 | 0 | 1 |
| 21 Jul. | Polovina | D | 744 | 1 | 2 | 0 | 1 |
| 22 Jul. | Zapadni | H | 210 | 0 | 0 | 0 | 0 |
| 22 Jul. | Little Zap. | H | 205 | 0 | 0 | 0 | 0 |
| 22 Jul. | Kitovi | D | 824 | 1 | 2 | 0 | 0 |
| 23 Jul. | Gorbatch | H | 920 | 2 | 4 | 0 | 5 |
| 24 Jul. | NE Point W | H | 126 | 2 | 0 | 0 | 0 |
| 24 Jul. | NE Point E | H | 278 | 0 | 6 | 1 ^h | 1 |
| 25 Jul. | Lukanin | H | 233 | 1 | 0 | 0 | 1 |
| 25 Jul. | Kitovi | H | 425 | 0 | 0 | 0 | 1 |
| 26 Jul. | Tolstoi | H | 326 | 1 | 2 | 0 | 2 |
| 26 Jul. | Zap. Reef | D | 191 | 0 | 2 | 0 | 0 |
| 27 Jul. | Castle Rock | D | 1515 | 6 | 12 | 1 ^h | 2 |
| 27 Jul. | NE Point E | D | 590 | 0 | 0 | 0 | 1 |
| 27 Jul. | NE Point W | D | 279 | 0 | 0 | 0 | 0 |
| 28 Jul. | Lukanin | D | 123 | 0 | 0 | 0 | 0 |
| 28 Jul. | Kitovi | D | 76 | 0 | 0 | 0 | 0 |
| 29 Jul. | Zapadni | H | 726 | 1 | 2 | 0 | 1 |
| 29 Jul. | Polovina | D | 446 | 1 | 2 | 0 | 1 |
| 29 Jul. | Zap. Reef | D | 430 | 2 | 4 | 0 | 2 |
| 30 Jul. | Gorbatch | H | 396 | 0 | 0 | 0 | 1 |
| 30 Jul. | Tolstoi | D | 989 | 2 | 4 | 0 | 2 |
| 31 Jul. | NE Point W | H | 235 | 0 | 0 | 0 | 0 |
| 31 Jul. | Zolotoi S. | D | 378 | 2 | 4 | 0 | 0 |
| 31 Jul. | Castle Rock | D | 1208 | 2 | 4 | 0 | 5 |
| 1 Aug. | Kitovi | D | 257 | 0 | 0 | 19 | 1 |
| 1 Aug. | Lukanin | D | 82 | 0 | 0 | 0 | 0 |
| 1 Aug. | Polovina | H | 440 | 1 | 2 | 0 | 1 |
| 2 Aug. | Tolstoi | H | 341 | 0 | 0 | 0 | 1 |
| 4 Aug. | Zap. Reef | D | 958 | 3 | 7 | 0 | 2 |
| 5 Aug. | Zapadni | H | 230 | 1 | 2 | 0 | 1 |

Table 7. -- Continued.

| Date | Location | Sample | Number ^a | Number of tags applied | | Not tagged | |
|---------|-------------|--------|---------------------|------------------------|---------|----------------|----------------|
| | | | | Debris | Control | Debris | Netmark |
| 5 Aug. | Little Zap. | H | 159 | 0 | 0 | 0 | 1 |
| 6 Aug. | Zolotoi S. | H | 495 | 1 | 2 | 0 | 0 |
| 6 Aug. | NE Point E | H | 418 | 1 | 2 | 0 | 6 |
| 7 Aug. | Gorbatch | D | 721 | 2 | 5 | 1 ^h | 1 ^h |
| 7 Aug. | Polovina | D | 230 | 1 | 2 | 0 | 2 |
| 7 Aug. | Castle Rock | I | - e | 2 | 4 | 0 | - |
| 7 Aug. | Tolstoi | D | 935 | 2 ⁱ | 4 | 0 | 1 |
| 8 Aug. | Zapadni | I | - e | 7 | 0 | 2 ^j | - |
| 8 Aug. | Zap. Reef | I | - e | 1 ^j | 0 | 0 | - |
| 9 Aug. | Zap. Reef | I | - e | 1 | 0 | 0 | - |
| 9 Aug. | NE Point E | I | - e | 5 | 0 | 0 | - |
| 9 Aug. | NE Point W | I | - e | 3 | 0 | 2 | - |
| 9 Aug. | Zapadni | I | - e | 0 | 14 | 0 | - |
| 9 Aug. | Tolstoi | I | - e | 0 | 2 | 0 | - |
| 9 Aug. | Lukanin | I | - e | 0 | 4 | 0 | - |
| 9 Aug. | Kitovi | I | - e | 0 | 2 | 0 | - |
| 9 Aug. | Castle Rock | I | - e | 0 | 3 | 0 | - |
| 10 Aug. | NE Point E | I | - e | 0 | 4 | 0 | - |
| 10 Aug. | NE Point W | I | - e | 1 | 12 | 0 | - |
| 10 Aug. | Zap. Reef | I | - | 0 | 1 | 0 | - |
| Totals | | | 22211 | 76 | 172 | 10 | 53 |

a Only seals of harvestable size were counted in these totals

b Died during handling

c Excluding 0017 and 0032, which had netmark but no debris

d Excluding 0042, which had netmark but no debris

e Driven as part of harvest but no seals harvested

f Number of seals driven not counted

g Seal of harvestable size

h Seal larger than harvestable size

i Debris accidentally removed during handling

j Female with pup

NOTES

Sample: seals sampled from harvests (H), entanglement drives (D), or incidentally to other activities (I).

Number: total number of harvestable-sized individuals.

Tags applied:

debris - seals entangled in debris.

control - unentangled seals tagged as controls.

Not tagged:

debris - seals entangled in debris, but not tagged because too large to capture and tag, or escaped during drive.

netmark - seals with netmarks were not tagged, but were sheared and released.

Table 8. --Summary of data for northern fur seal males tagged in 1985 during debris entanglement studies on St. Paul Island, Alaska. A dash indicates no data.

| Tag no. | Debris type and color | Quantity | Mesh size | Twine size | Number meshes | Tight/ loose | Degree wound |
|---------|-----------------------|----------|-----------|------------|---------------|--------------|--------------|
| 0001 | white cord | S | -- | -- | 1 | T | 360 |
| 0002 | gray trawl | S | -- | 2.5 | 1 | T | 22 |
| 0004 | green/gray trawl | M | 21.0 | 4.0 | 7 | T | 0 |
| 0013 | green trawl | S | 25.5 | 3.0 | 3 | T | 0 |
| 0018 | green trawl | L | 22.5 | 3.5 | 17 | TNB | 0 |
| 0019 | poly line, gillnet | S | -- | 6.2 | - | T | 180 |
| 0028 | black poly line | S | -- | 3.1 | 1 | T | 180 |
| 0033 | black trawl | S | -- | 2.0 | 5 | L | 0 |
| 0036 | green trawl | M | 21.5 | 3.5 | 17 | T | 0 |
| 0037 | black line | S | -- | 2.5 | 1 | T | 355 |
| 0044 | syn. white cord | S | 27.0 | 1.5 | 3 | L | 0 |
| 0047 | white line or cord | S | -- | 6.2 | 1 | T | 360 |
| 0050 | yellow band | S | -- | -- | 1 | L | 0 |
| 0054 | green trawl | S | -- | 2.5 | 1 | T | 360 |
| 0055 | green band | S | -- | -- | 1 | L | 0 |
| 0058 | green trawl | S | 26.0 | 3.5 | - | TNB | 0 |
| 0065 | white band | S | -- | -- | 1 | VT | 360 |
| 0066 | gray trawl | M | 11.5 | 3.7 | 3 | -- | 360 |
| 0069 | blue trawl | S | 22.0 | 3.0 | - | -- | 0 |
| 0072 | gray trawl | S | 22.5 | 3.0 | 6 | TNB | 0 |
| 0075 | blue trawl | M | 24.0 | 3.5 | - | T | 0 |
| 0078 | blue trawl | S | -- | -- | 1 | T | <90 |
| 0081 | brown line | S | -- | -- | 1 | L | 0 |
| 0084 | gray trawl | M | 20.0 | -- | - | TNB | 0 |
| 0085 | gray trawl | S | 20.0 | -- | 3 | -- | 0 |
| 0086 | green trawl | M | 20.0 | 3.0 | 12 | TNB | 0 |
| 0095 | yellow band | S | -- | -- | 1 | L | 0 |
| 0096 | green band | S | -- | -- | 1 | L | 0 |
| 0099 | gray line | S | -- | 1.8 | 2 | T | 180 |
| 0102 | white line | S | -- | -- | 1 | VT | 360 |
| 0103 | green trawl | S | -- | -- | - | VT | 360 |
| 0108 | gray trawl | S | -- | 3.4 | - | T | 360 |
| 0109 | white cord | S | -- | -- | 1 | L | 0 |
| 0118 | green trawl | S | 23.0 | 3.1 | - | T | 0 |
| 0119 | green trawl | M | 22.5 | 3.5 | 15 | T | 0 |
| 0122 | green gillnet | S | -- | 0.5 | - | VT | 30 |
| 0125 | blue trawl | S | 22.5 | 2.0 | - | T | 50 |
| 0128 | gray trawl | S | 22.0 | 4.5 | 5 | T | 360 |
| 0131 | gray trawl | S | 22.5 | 3.3 | - | L | 0 |
| 0134 | green/gray trawl | L | 37.0 | 3.2 | - | TNB | 0 |
| 0137 | blue trawl | S | 22.5 | 2.5 | - | T | 360 |
| 0140 | orange trawl | S | 19.0 | 4.0 | - | TNB | 0 |
| 0143 | syn. black line | S | -- | -- | 1 | T | 0 |
| 0144 | blue trawl | M | 23.0 | 2.4 | 12 | T | 0 |

Table 8. --- Continued.

| Tag no. | Debris type and color | Quantity | Mesh size | Twine size | Number meshes | Tight/ loose | Degree wound |
|---------|-----------------------|----------|-----------|------------|---------------|--------------|--------------|
| 0149 | gray trawl | S | -- | 4.2 | 4 | -- | 0 |
| 0152 | gray trawl | S | -- | -- | 3 | T | 360 |
| 0155 | gray trawl | S | -- | -- | 3 | T | 360 |
| 0156 | green trawl | M | 23.0 | 3.0 | 25 | L | 0 |
| 0161 | green trawl | M | 23.5 | 5.0 | - | TNB | 0 |
| 0164 | gray trawl | S | -- | -- | 4 | -- | 0 |
| 0167 | green trawl | M | 23.5 | 2.4 | 12 | T | 0 |
| 0170 | yellow band | S | -- | -- | 1 | VT | 360 |
| 0175 | orange trawl | S | 25.5 | 5.0 | 4 | L | 0 |
| 0177 | blue trawl | M | 24.0 | 3.5 | - | TNB | 0 |
| 0180 | blue trawl | S | -- | -- | - | VT | 120 |
| 0181 | gray trawl | L | 23.5 | 3.5 | >5 | T | 0 |
| 0186 | green line | S | -- | 5.0 | 1 | VT | 270 |
| 0187 | ivory trawl* | S | 20.5 | 3.5 | 1 | VT | 200 |
| 0192 | green trawl | L | 23.0 | 4.0 | >10 | TNB | 0 |
| 0193 | gray trawl | M | -- | 3.0 | 3 | TNB | 0 |
| 0194 | green trawl | S | -- | 3.0 | 1 | VT | 120 |
| 0195 | orange line/handle | S | -- | 5.0 | 1 | TNB | 0 |
| 0196 | green trawl | S | 23.0 | 2.5 | 5 | TNB | 0 |
| 0197 | green/pink trawl | M | 23.5 | 2.0 | 4 | TNB | 0 |
| 0198 | green trawl | S | -- | 3.0 | 3 | VT | 360 |
| 0199 | gray trawl | S | -- | 3.5 | 3 | T | 0 |
| 0200 | green trawl | S | 21.0 | 3.0 | 2 | TNB | 0 |
| 0201 | gray trawl | S | -- | 4.5 | 2 | VT | 360 |
| 0202 | green trawl | M | 22.0 | 2.5 | 7 | TNB | 0 |
| 0203 | yellow band | S | -- | -- | 1 | VT | 360 |
| 0204 | green trawl | S | 21.5 | 2.5 | 3 | TNB | 0 |
| 0205 | yellow band | S | -- | -- | 1 | VT | 360 |
| 0206 | white cord | S | -- | -- | 2 | VT | 360 |
| 0207 | gray trawl | S | 24.0 | 2.0 | 4 | TNB | 0 |
| 0208 | gray trawl | M | 23.0 | 7.0 | 2 | T | 0 |
| 0238 | green trawl | S | -- | 2.0 | 2 | TNB | 0 |

* Cut off during handling.

NOTES

Tags: all tags applied in 1985 were orange Allflex.

Quantity: S = < 150 grams of debris.

M = 150 - 500 grams of debris.

L = > 500 grams of debris.

Mesh size: measurements indicate stretch mesh length (cm).

Twine size: measurements indicate twine diameter (mm).

Number meshes: number of strands of debris looped around neck.

Tight/loose: L = debris attached loosely.

TNB = debris tight but not binding.

T = debris attached tightly.

VT = debris attached very tightly.

Degree Wound: open wound along point of entanglement expressed as degrees of a circle.

Table 9. --Tags resighted on northern fur seals at St. Paul Island, Alaska, in 1985 during harvest and research activities.

| Tag | | Date | Location | Comment ^a |
|------------------|---------------|---------|--------------|--------------------------------|
| no. | color | | | |
| 507 | blue | 6 July | Zapadni Reef | female (1984) |
| 2705 | white | 6 July | Zapadni Reef | female (1984) |
| bA642 | monel, silver | 8 July | Polovina | no debris or marks (USSR) |
| 404 | blue | 9 July | Gorbatch | entangled |
| 534 | blue | 9 July | Gorbatch | netmark but no debris |
| 3448 | yellow | 10 July | Tolstoi | entangled |
| 581 | blue | 10 July | Tolstoi | entangled |
| 1224 | white | 10 July | Tolstoi | no debris or marks |
| 2710 | white | 10 July | Zapadni Reef | female (1984) |
| 308 | blue | 12 July | Zapadni Reef | female (1984) |
| 0005 | orange | 11 July | Zapadni | control |
| 0016 | orange | 11 July | Zapadni | control |
| 579 | blue | 11 July | Zapadni | no debris or marks |
| 817/818 | pink | 12 July | NE Point E | netmark |
| 0018 | orange | 15 July | Zapadni | entangled |
| 811 | pink | 16 July | Gorbatch | netmark |
| 0003 | orange | 16 July | Gorbatch | control |
| 0004 | orange | 16 July | Gorbatch | entangled |
| 0001 | orange | 16 July | Gorbatch | entangled |
| 1224 | white | 16 July | Gorbatch | no debris or marks |
| 534 | blue | 16 July | Gorbatch | no debris or marks |
| 5220 | yellow | 16 July | Gorbatch | no debris or marks |
| 527 ^b | blue | 17 July | NE Point E | killed |
| 544 | blue | 17 July | NE Point E | no debris or marks |
| MA2990 | monel, silver | 17 July | NE Point E | killed (USSR) |
| 540 | blue | 17 July | NE Point E | no debris or marks |
| 2575 | yellow | 17 July | NE Point E | no debris or marks |
| 0041 | orange | 17 July | NE Point E | control |
| 0008 | orange | 18 July | Polovina | control |
| HB7716+ | | | | female (additional tag |
| HB7725 | monel, silver | 18 July | NE Point W | #5069 white applied) (USSR) |
| 436 | blue | 19 July | Little Zap. | entangled |
| 0044 | orange | 19 July | Little Zap. | entangled |
| TM9373 | monel, silver | 19 July | Little Zap. | killed (USSR) |
| 0062 | orange | 20 July | Zapadni Reef | control |
| 560 | blue | 20 July | Zapadni Reef | entangled |
| 3665 | yellow | 20 July | Zapadni Reef | no debris or marks |
| 0033 | orange | 20 July | Tolstoi | entangled |
| 0061 | orange | 20 July | Tolstoi | control |
| 0042 | orange | 20 July | Tolstoi | netmark |
| 204 | yellow | 21 July | Polovina | netmark |
| 809/810 | pink | 21 July | Polovina | netmark |
| 0058 | orange | 21 July | Polovina | entangled |
| 0059 | orange | 21 July | Polovina | control |
| 0008 | orange | 22 July | Kitovi | control |

Table 9. --Continued.

| Tag | | Date | Location | Comment ^a |
|---------|---------------|---------|---------------|------------------------------|
| no. | color | | | |
| 555 | blue | 22 July | Kitovi | entangled |
| 476 | blue | 22 July | Kitovi | no debris or marks |
| 0030 | orange | 23 July | Gorbatch | control |
| 0020 | orange | 23 July | Gorbatch | control |
| 0051 | orange | 23 July | Gorbatch | control |
| 563 | blue | 25 July | Lukanin | entangled |
| 555 | blue | 25 July | Kitovi | entangled |
| 476 | blue | 25 July | Kitovi | netmark |
| 1130 | yellow | 25 July | Kitovi | netmark |
| YM2269 | monel, silver | 26 July | Tolstoi | no debris or marks (USSR) |
| 2363 | yellow | 27 July | Castle Rock | no debris or marks |
| 1122 | blue | 27 July | Castle Rock | no debris or marks |
| 821/822 | pink | 27 July | Castle Rock | netmark (photo) |
| 429 | blue | 27 July | Castle Rock | no debris or marks |
| 0042 | orange | 27 July | NE Point E | netmark |
| 0005 | orange | 27 July | NE Point E | control |
| 0091 | orange | 27 July | NE Point E | control |
| 0089 | orange | 27 July | NE Point E | control |
| TM9809 | monel | 28 July | Lukanin | USSR |
| 0098 | orange | 28 July | Lukanin | entangled |
| 2707 | white | 28 July | Zapadni Reef | female (1984) |
| 0106 | orange | 29 July | Polovina | control |
| 741 | yellow | 29 July | Polovina | no debris or marks |
| 0075 | orange | 29 July | Polovina | entangled |
| 0070 | orange | 29 July | Zapadni Reef | control |
| 0102 | orange | 29 July | Zapadni Reef | entangled |
| 0081 | orange | 29 July | Zapadni Reef | entangled |
| 0002 | orange | 29 July | Zapadni Reef | entangled |
| 552 | blue | 29 July | Zapadni | entangled |
| MC2049 | monel, silver | 29 July | Zapadni | no debris or marks (USSR) |
| 0002 | orange | 29 July | Zapadni | entangled |
| 0102 | orange | 29 July | Zapadni | entangled |
| 0129 | orange | 30 July | Tolstoi | control |
| 0034 | orange | 30 July | Tolstoi | control |
| 0070 | orange | 30 July | Tolstoi | control |
| 0126 | orange | 30 July | Tolstoi | control |
| 581 | blue | 30 July | Tolstoi | entangled |
| 557 | blue | 30 July | Tolstoi | no debris or marks |
| 585 | blue | 30 July | Tolstoi | netmark |
| 0130 | orange | 30 July | Gorbatch | control |
| 0117 | orange | 30 July | Gorbatch | control |
| 0128 | orange | 31 July | Zolotoi Sands | entangled |
| 0121 | orange | 31 July | Zolotoi Sands | control |
| TM9809 | monel, silver | 31 July | Castle Rock | USSR |
| 0108 | orange | 31 July | Castle Rock | entangled |
| 0095 | orange | 31 July | Castle Rock | entangled |

Table 9.--Continued.

| Tag | | Date | Location | Comment ^a |
|--------|---------------|---------|----------------|------------------------------|
| no. | color | | | |
| 0122 | orange | 31 July | Castle Rock | entangled |
| 0105 | orange | 31 July | Castle Rock | control |
| 0053 | orange | 31 July | Castle Rock | control |
| 0096 | orange | 31 July | Castle Rock | entangled |
| 0132 | orange | 31 July | Castle Rock | control |
| 492 | blue | 1 Aug. | Gorbatch blind | entangled female |
| 0075 | orange | 1 Aug. | Polovina | entangled |
| 563 | blue | 1 Aug. | Polovina | entangled |
| BA1129 | monel, silver | 2 Aug. | Tolstoi | no debris or marks (USSR) |
| 4964 | yellow | 4 Aug. | Zapadni Reef | no debris or marks |
| 0016 | orange | 4 Aug. | Zapadni Reef | control |
| 0127 | orange | 5 Aug. | Zapadni | control |
| TM9925 | monel, silver | 5 Aug. | Little Zap. | no debris or marks (USSR) |
| BA825 | monel, silver | 6 Aug. | Zolotoi Sands | no debris or marks (USSR) |
| 549 | blue | 6 Aug. | Zolotoi Sands | no debris or marks |
| YM2332 | monel, silver | 6 Aug. | NE Point E | no debris or marks (USSR) |
| 2841 | yellow | 6 Aug. | NE Point E | no debris or marks |
| 0074 | orange | 7 Aug. | Gorbatch | control |
| 534 | blue | 7 Aug. | Gorbatch | netmark |
| 0152 | orange | 7 Aug. | Gorbatch | entangled |
| 0117 | orange | 7 Aug. | Gorbatch | control |
| TM8237 | monel, silver | 7 Aug. | Polovina | no debris or marks (USSR) |
| 573 | blue | 7 Aug. | Castle Rock | entangled |
| 527b | blue | 7 Aug. | Castle Rock | entangled |
| 0164 | orange | 7 Aug. | Castle Rock | entangled |
| 558 | blue | 7 Aug. | Tolstoi | entangled |
| 0027 | orange | 7 Aug. | Tolstoi | control |
| 0158 | orange | 7 Aug. | Tolstoi | control |
| 0034 | orange | 7 Aug. | Tolstoi | control |
| 595 | blue | 8 Aug. | Zapadni Reef | female (1984) |
| TM9508 | monel, silver | 8 Aug. | Zapadni | no debris or marks (USSR) |
| YM2332 | monel, silver | 9 Aug. | NE Point E | no debris or marks (USSR) |
| 548 | blue | 9 Aug. | NE Point E | entangled |
| 424 | blue | 9 Aug. | Zapadni | entangled |

^a A separate list of USSR tags is given in Appendix Table A-8.

^b This tag number is repeated and hence in error in one or both cases.

Table 10. --Northern fur seals resighted in 1985 at St. Paul Island, Alaska, tagged^a in previous years during entanglement studies. A dash indicates no data.

| Tag no. | 1983 | 1954 | 1985 |
|---------|----------------------------------|---------------------------------|-----------------------|
| 404 | green net ^b T-360° | - | entangled |
| 424 | green net VT-360° | - | entangled |
| 429 | green net TNB-0° | no debris or marks | no debris or marks |
| 436 | green net TNB-cut | net - bad cut | entangled |
| 476 | plastic mesh T-0° | netmark | netmark |
| 492 | gray net TNB-0° | - | entangled |
| 527 | - | yellow band T-0° | harvested |
| 534 | - | gillnet T-180° | netmark |
| 540 | - | black & white band TNB-0° | no debris or marks |
| 544 | - | gray net T-90° | no debris or marks |
| 548 | - | gray net T-0° | entangled |
| 549 | - | gray net VT-0° | no debris or marks |
| 552 | - | blue net T-330° | entangled |
| 555 | - | gray net TNB-0° | entangled |
| 557 | - | gray net T-0° | no debris or marks |

Table 10.--Continued.

| Tag no. | 1983 | 1984 | 1985 |
|------------|------|------------------------|-----------------------|
| 558 | - | green net T-0° | entangled |
| 560 | - | manila-string VT-0° | entangled |
| 563 | - | gray net T-0° | entangled |
| 573 | - | yellow band T-160° | entangled |
| 579 | - | yellow rope TNB-0° | no debris or marks |
| 581 | - | green net TNB-0° | entangled |
| 585 | - | gillnet T-C | netmark |

a Blue jumbo Roto tag.

b TNB = debris tight but not binding.

T = debris attached tightly.

VT = debris attached very tightly.

T-360° = debris attached tightly and open wound expressed as degrees
of a circle.

c Seal had a series of small unconnected open wounds 360° around its neck.

which they had escaped) were counted but not tagged (these individuals were given pelage marks by shearing to identify that they had already been counted during the season).

A total of 124 previously tagged seals were sighted during research and harvest activities in 1985 (Table 9). Of these, 22 had been entangled at the time when they were first tagged. Table 10 outlines the status of entangled seals tagged in 1983 and 1984 and resighted during the 1985 season. A comparison of types of debris observed on fur seals during harvest and research activities from 1981-85 is given in Table 11.

For each entangled seal that was tagged (or had a tag from a previous season), two unentangled seals from the same haul-out site were tagged and released to serve as experimental controls (Table 12). Resighting efforts in subsequent seasons will allow the estimation of mortality rates (tag returns) for both the entangled seals and the control seals. By comparing these rates, it will be possible to evaluate the impact that relatively small (<1 kg) pieces of netting and other debris have on the survival of juvenile males.

Because there was no commercial harvest of fur seals on St. Paul Island in 1985, estimates of entanglement rates for that season cannot be considered strictly comparable with past estimates. Seals counted in research roundups were released unharmed; during harvests in past years, most of them were killed. Therefore, some seals could be released and counted again during research roundups. To eliminate multiple counts of the same seal, only those entangled seals seen for the first time are counted. To make the estimates from roundups as

Table 11. --Types of entangling debris observed on northern fur seals during the harvest or entanglement research roundups on St. Paul Island, Alaska, 1981-85.

| Type of debris | Number of seals | | | | | Total |
|--------------------------------------|-----------------|----------|----------|----------|----------|----------|
| | 1981 | 1982 | 1983 | 1984 | 1985* | |
| Net fragment | | | | | | |
| mesh size over 20 cm | 45 | 52 | 52 | 37 | 34 | 220 |
| mesh size under 20 cm | 4 | 5 | 6 | 3 | 2 | 20 |
| undetermined mesh size | 19 | 5 | 21 | 10 | 17 | 72 |
| Monofilament gillnet fragment | 0 | 3 | 2 | 4 | 2 | 11 |
| Cord used in net construction/repair | 3 | 4 | 2 | 2 | 5 | 16 |
| Plastic packing band | 20 | 26 | 18 | 20 | 8 | 92 |
| String | 5 | 3 | 2 | 4 | 0 | 14 |
| Rope or line | 1 | 2 | 2 | 5 | 7 | 17 |
| Rubber band | 3 | 0 | 1 | 0 | 0 | 4 |
| Plastic ring | 1 | 0 | 1 | 1 | 0 | 3 |
| Plastic gasket | 0 | 0 | 2 | 0 | 0 | 2 |
| Monofilament line | 0 | 1 | 0 | 0 | 0 | 1 |
| Plastic six-pack holder | 0 | 1 | 0 | 0 | 0 | 1 |
| Plastic packing web | 0 | 0 | 1 | 0 | 0 | 1 |
| Plastic object | 0 | 0 | 0 | 1 | 0 | 1 |
| Lawn chair material | 1 | 0 | 0 | 0 | 0 | 1 |
| Cloth sack band | 0 | 0 | 1 | 0 | 0 | 1 |
| Metal headlight ring | 0 | 0 | 1 | 0 | 0 | 1 |
| Plastic line with handle | <u>0</u> | <u>0</u> | <u>0</u> | <u>0</u> | <u>1</u> | <u>1</u> |
| Total | 102 | 102 | 112 | 87 | 76 | 479 |

* Does not include seals resighted from previous years entanglement studies (see Table 10).

Table 12. --Northern fur seal males tagged in 1985 as part of debris entanglement studies on St. Paul Island, Alaska. All tags are orange Allflex.

| Tag no. | Debris type/color | Date | Location |
|---------|-------------------|---------|------------|
| 0001 | white band | 9 July | Gorbatch |
| 0002 | gray trawl | 9 July | Gorbatch |
| 0003 | control | 9 July | Gorbatch |
| 0004 | gray/green trawl | 9 July | Gorbatch |
| 0005 | control | 9 July | Gorbatch |
| 0006 | control | 9 July | Gorbatch |
| 0007 | control | 9 July | Gorbatch |
| 0008 | control | 9 July | Gorbatch |
| 0009 | control | 9 July | Gorbatch |
| 0010 | control | 9 July | Gorbatch |
| 0011 | control | 9 July | Gorbatch |
| 0012 | control | 10 July | Tolstoi |
| 0013 | green trawl | 10 July | Tolstoi |
| 0014 | control | 10 July | Tolstoi |
| 0015 | control | 10 July | Tolstoi |
| 0016 | control | 10 July | Tolstoi |
| 0017 | netmark | 11 July | Zapadni |
| 0018 | green trawl | 11 July | Zapadni |
| 0019 | rope/gill net | 11 July | Zapadni |
| 0020 | control | 11 July | Zapadni |
| 0021 | control | 11 July | Zapadni |
| 0022 | control | 11 July | Zapadni |
| 0023 | control | 11 July | Zapadni |
| 0024 | TAG NOT USED | | |
| 0025 | control | 11 July | Zapadni |
| 0026 | control | 11 July | Zapadni |
| 0027 | control | 11 July | Zapadni |
| 0028 | black line | 11 July | Zapadni |
| 0029 | control | 11 July | Zapadni |
| 0030 | control | 11 July | Zapadni |
| 0031 | control | 11 July | Zapadni |
| 0032 | netmark | 11 July | Zapadni |
| 0033 | black trawl | 11 July | Zapadni |
| 0034 | control | 12 July | NE Point E |
| 0035 | control | 12 July | NE Point E |
| 0036 | green trawl | 12 July | NE Point E |
| 0037 | black line | 12 July | NE Point E |
| 0038 | control | 12 July | NE Point E |
| 0039 | control | 12 July | NE Point E |
| 0040 | control | 12 July | NE Point E |
| 0041 | control | 12 July | NE Point E |
| 0042 | netmark | 15 July | Zapadni |
| 0043 | control | 15 July | Zapadni |

Table 12. -- Continued.

| Tag no. | Debris type/color | Date | Location |
|---------|-------------------|---------|----------------|
| 0044 | white line | 15 July | Zapadni |
| 0045 | control | 15 July | Zapadni |
| 0046 | control | 16 July | Gorbatch |
| 0047 | white line | 16 July | Gorbatch |
| 0048 | control | 16 July | Gorbatch |
| 0049 | control | 16 July | Gorbatch |
| 0050 | yellow band | 16 July | Gorbatch |
| 0051 | control | 16 July | Gorbatch |
| 0052 | control | 16 July | Gorbatch |
| 0053 | control | 16 July | Gorbatch |
| 0054 | green trawl | 16 July | Gorbatch |
| 0055 | green trawl | 17 July | NE Point W |
| 0056 | control | 17 July | NE Point W |
| 0057 | control | 17 July | NE Point W |
| 0058 | green trawl | 18 July | Polovina |
| 0059 | control | 18 July | Polovina |
| 0060 | control | 18 July | Polovina |
| 0061 | control | 19 July | Little Zapadni |
| 0062 | control | 19 July | Little Zapadni |
| 0063 | control | 19 July | Little Zapadni |
| 0064 | control | 19 July | Little Zapadni |
| 0065 | white band | 19 July | Little Zapadni |
| 0066 | gray trawl | 20 July | Zapadni Reef |
| 0067 | control | 20 July | Zapadni Reef |
| 0068 | control | 20 July | Zapadni Reef |
| 0069 | blue trawl | 20 July | Tolstoi |
| 0070 | control | 20 July | Tolstoi |
| 0071 | control | 20 July | Tolstoi |
| 0072 | gray trawl | 20 July | Tolstoi |
| 0073 | control | 20 July | Tolstoi |
| 0074 | control | 20 July | Tolstoi |
| 0075 | blue trawl | 21 July | Polovina |
| 0076 | control | 21 July | Polovina |
| 0077 | control | 21 July | Polovina |
| 0078 | blue band | 23 July | Gorbatch |
| 0079 | control | 23 July | Gorbatch |
| 0080 | control | 23 July | Gorbatch |
| 0081 | brown rope | 23 July | Gorbatch |
| 0082 | control | 23 July | Gorbatch |
| 0083 | control | 23 July | Gorbatch |
| 0084 | gray trawl | 24 July | NE Point W |
| 0085 | gray trawl | 24 July | NE Point W |
| 0086 | green trawl | 22 July | Kitovi |

Table 12. ---Continued.

| Tag no. | Debris type/color | Date | Location |
|---------|-------------------|---------|--------------|
| 0087 | control | 22 July | Kitovi |
| 0088 | control | 22 July | Kitovi |
| 0089 | control | 24 July | NE Point E |
| 0090 | control | 24 July | NE Point E |
| 0091 | control | 24 July | NE Point E |
| 0092 | control | 24 July | NE Point E |
| 0093 | control | 24 July | NE Point E |
| 0094 | control | 24 July | NE Point E |
| 0095 | yellow band | 25 July | Lukanin |
| 0096 | green band | 26 July | Tolstoi |
| 0097 | control | 26 July | Tolstoi |
| 0098 | control | 26 July | Tolstoi |
| 0099 | gray line | 29 July | Zapadni |
| 0100 | control | 26 July | Zapadni Reef |
| 0101 | control | 26 July | Zapadni Reef |
| 0102 | white line | 27 July | Castle Rock |
| 0103 | green trawl | 27 July | Castle Rock |
| 0104 | control | 27 July | Castle Rock |
| 0105 | control | 27 July | Castle Rock |
| 0106 | control | 27 July | Castle Rock |
| 0107 | control | 27 July | Castle Rock |
| 0108 | gray trawl | 27 July | Castle Rock |
| 0109 | white twine | 27 July | Castle Rock |
| 0110 | control | 27 July | Castle Rock |
| 0111 | control | 27 July | Castle Rock |
| 0112 | control | 27 July | Castle Rock |
| 0113 | control | 27 July | Castle Rock |
| 0114 | control | 27 July | Castle Rock |
| 0115 | control | 27 July | Castle Rock |
| 0116 | control | 27 July | Castle Rock |
| 0117 | control | 27 July | Castle Rock |
| 0118 | green trawl | 27 July | Castle Rock |
| 0119 | green trawl | 27 July | Castle Rock |
| 0120 | control | 29 July | Zapadni |
| 0121 | control | 29 July | Zapadni |
| 0122 | green gill net | 29 July | Polovina |
| 0123 | control | 29 July | Polovina |
| 0124 | control | 29 July | Polovina |
| 0125 | blue trawl | 29 July | Zapadni Reef |
| 0126 | control | 29 July | Zapadni Reef |
| 0127 | control | 29 July | Zapadni Reef |
| 0128 | gray trawl | 29 July | Zapadni Reef |
| 0129 | control | 29 July | Zapadni Reef |
| 0130 | control | 29 July | Zapadni Reef |

Table 12. --Continued.

| Tag no. | Debros type/color | Date | Location |
|------------|----------------------|---------|---------------|
| 0131 | gray trawl | 30 July | Tolstoi |
| 0132 | control | 30 July | Tolstoi |
| 0133 | control | 30 July | Tolstoi |
| 0134 | green/gray/white tr. | 30 July | Tolstoi |
| 0135 | control | 30 July | Tolstoi |
| 0136 | control | 30 July | Tolstoi |
| 0137 | blue trawl | 31 July | Zolotoi Sands |
| 0138 | control | 31 July | Zolotoi Sands |
| 0139 | control | 31 July | Zolotoi Sands |
| 0140 | orange trawl | 31 July | Zolotoi Sands |
| 0141 | control | 31 July | Zolotoi Sands |
| 0142 | control | 31 July | Zolotoi Sands |
| 0143 | black rope | 31 July | Castle Rock |
| 0144 | green trawl | 31 July | Castle Rock |
| 0145 | control | 31 July | Castle Rock |
| 0146 | control | 31 July | Castle Rock |
| 0147 | control | 31 July | Castle Rock |
| 0148 | control | 31 July | Castle Rock |
| 0149 | gray trawl | 1 Aug. | Polovina |
| 0150 | control | 1 Aug. | Polovina |
| 0151 | control | 1 Aug. | Polovina |
| 0152 | gray trawl | 4 Aug. | Zapadni Reef |
| 0153 | control | 4 Aug. | Zapadni Reef |
| 0154 | control | 4 Aug. | Zapadni Reef |
| 0155 | gray trawl | 4 Aug. | Zapadni Reef |
| 0156 | green trawl | 4 Aug. | Zapadni Reef |
| 0157 | control | 4 Aug. | Zapadni Reef |
| 0158 | control | 4 Aug. | Zapadni Reef |
| 0159 | control | 4 Aug. | Zapadni Reef |
| 0160 | control | 4 Aug. | Zapadni Reef |
| 0161 | green trawl | 5 Aug. | Zapadni |
| 0162 | control | 5 Aug. | Zapadni |
| 0163 | control | 5 Aug. | Zapadni |
| 0164 | gray trawl | 6 Aug. | Zolotoi Sands |
| 0165 | control | 6 Aug. | Zolotoi Sands |
| 0166 | control | 6 Aug. | Zolotoi Sands |
| 0167 | green trawl | 6 Aug. | NE Point E |
| 0168 | control | 6 Aug. | NE Point E |
| 0169 | control | 6 Aug. | NE Point E |
| 0170 | yellow band | 7 Aug. | Gorbatch |
| 0171 | control | 7 Aug. | Gorbatch |
| 0172 | control | 7 Aug. | Gorbatch |
| 0173 | control | 7 Aug. | Gorbatch |
| 0174 | control | 7 Aug. | Gorbatch |

Table 12 --- Continued.

| Tag no. | Debris type/color | Date | Location |
|------------|--------------------------|--------|--------------|
| 0175 | orange trawl | 7 Aug. | Gorbatch |
| 0176 | control | 7 Aug. | Gorbatch |
| 0177 | green trawl | 7 Aug. | Polovina |
| 0178 | control | 7 Aug. | Polovina |
| 0179 | control | 7 Aug. | Polovina |
| 0180 | blue trawl | 7 Aug. | Castle Rock |
| 0181 | gray trawl | 7 Aug. | Castle Rock |
| 0182 | control | 7 Aug. | Castle Rock |
| 0183 | control | 7 Aug. | Castle Rock |
| 0184 | control | 7 Aug. | Castle Rock |
| 0185 | control | 7 Aug. | Castle Rock |
| 0186 | green line | 7 Aug. | Tolstoi |
| 0187 | ivory trawl ^a | 7 Aug. | Tolstoi |
| 0188 | control | 7 Aug. | Tolstoi |
| 0189 | control | 7 Aug. | Tolstoi |
| 0190 | control | 7 Aug. | Tolstoi |
| 0191 | control | 7 Aug. | Tolstoi |
| 0192 | green trawl ^b | 8 Aug. | Zapadni Reef |
| 0193 | gray trawl | 8 Aug. | Zapadni |
| 0194 | green trawl | 8 Aug. | Zapadni |
| 0195 | orange line w/handle | 8 Aug. | Zapadni |
| 0196 | green trawl | 8 Aug. | Zapadni |
| 0197 | green/pink trawl | 8 Aug. | Zapadni |
| 0198 | green trawl | 8 Aug. | Zapadni |
| 0199 | gray trawl | 8 Aug. | Zapadni |
| 0200 | green trawl | 9 Aug. | Zapadni Reef |
| 0201 | gray trawl | 9 Aug. | NE Point E |
| 0202 | green trawl | 9 Aug. | NE Point E |
| 0203 | yellow band | 9 Aug. | NE Point E |
| 0204 | green trawl | 9 Aug. | NE Point E |
| 0205 | yellow band | 9 Aug. | NE Point E |
| 0206 | white cord | 9 Aug. | NE Point W |
| 0207 | gray trawl | 9 Aug. | NE Point W |
| 0208 | gray trawl | 9 Aug. | NE Point W |
| 0209 | control | 9 Aug. | Zapadni |
| 0210 | control | 9 Aug. | Zapadni |
| 0211 | control | 9 Aug. | Zapadni |
| 0212 | control | 9 Aug. | Zapadni |
| 0213 | control | 9 Aug. | Zapadni |
| 0214 | control | 9 Aug. | Zapadni |
| 0215 | control | 9 Aug. | Zapadni |
| 0216 | control | 9 Aug. | Zapadni |
| 0217 | control | 9 Aug. | Zapadni |
| 0218 | control | 9 Aug. | Zapadni |

Table 12 --- Continued.

| Tag no. | Debris type/color | Date | Location |
|---------|-------------------|---------|--------------|
| 0219 | control | 9 Aug. | Zapadni |
| 0220 | control | 9 Aug. | Zapadni |
| 0221 | control | 9 Aug. | Zapadni |
| 0222 | control | 9 Aug. | Zapadni |
| 0223 | control | 9 Aug. | Tolstoi |
| 0224 | control | 9 Aug. | Tolstoi |
| 0225 | control | 9 Aug. | Lukanin |
| 0226 | control | 9 Aug. | Lukanin |
| 0227 | control | 9 Aug. | Lukanin |
| 0228 | control | 9 Aug. | Lukanin |
| 0229 | control | 9 Aug. | Kitovi |
| 0230 | control | 9 Aug. | Kitovi |
| 0231 | control | 9 Aug. | Castle Rock |
| 0232 | control | 9 Aug. | Castle Rock |
| 0233 | control | 9 Aug. | Castle Rock |
| 0234 | control | 10 Aug. | NE Point E |
| 0235 | control | 10 Aug. | NE Point E |
| 0236 | control | 10 Aug. | NE Point E |
| 0237 | control | 10 Aug. | NE Point E |
| 0238 | green trawl | 10 Aug. | NE Point W |
| 0239 | control | 10 Aug. | NE Point W |
| 0240 | control | 10 Aug. | NE Point W |
| 0241 | control | 10 Aug. | NE Point W |
| 0242 | control | 10 Aug. | NE Point W |
| 0243 | control | 10 Aug. | NE Point W |
| 0244 | control | 10 Aug. | NE Point W |
| 0245 | control | 10 Aug. | NE Point W |
| 0246 | control | 10 Aug. | NE Point W |
| 0247 | control | 10 Aug. | NE Point W |
| 0248 | control | 10 Aug. | NE Point W |
| 0249 | control | 10 Aug. | NE Point W |
| 0250 | control | 10 Aug. | NE Point W |
| 0251 | control | 10 Aug. | Zapadni Reef |

^a Debris cut off during handling.

^b Female with pup.

Table 13.--Northern fur seals entangled in fishing debris and other materials, St. Paul Island, Alaska, 1967-85.^a

| Year | Number of seals in drives of harvestable size | Number of entangled seals observed in drives ^b | Percent of harvest or entanglement drives |
|-------------------|---|---|--|
| 1967 | 50,229 | 75 | 0.15 |
| 1968 | 46,893 | 75 | 0.16 |
| 1969 | 32,819 | 66 | 0.20 |
| 1970 | 36,307 | 101 | 0.28 |
| 1971 | 27,289 | 113 | 0.41 |
| 1972 | 33,173 | 144 | 0.43 |
| 1973 | 28,482 | 137 | 0.48 |
| 1974 | 33,027 | 190 | 0.58 |
| 1975 | 29,148 | 206 | 0.71 |
| 1976 | 23,096 | 97 | 0.42 |
| 1977 | 28,444 | 99 | 0.35 |
| 1978 | 24,885 | 115 | 0.46 |
| 1979 | 25,762 | 104 | 0.40 |
| 1980 | 24,327 | 119 | 0.49 |
| 1981 | 23,928 | 102 | 0.43 |
| 1982 | 24,828 | 102 | 0.41 |
| 1983 | 25,768 | 112 | 0.43 |
| 1984 | 22,066 | 87 | 0.39 |
| 1985 ^c | 22,211 | 101 ^d | 0.45 |

^a Some of these data are different from previously published tables (see Scordino, J., and R. Fisher. 1983. Investigations of fur seal entanglement in net fragments, plastic bands, and other debris in 1981 and 1982, St. Paul Island, Alaska. Unpub. manusc., 33 p. plus appendix. Northwest Regional Office, National Marine Fisheries Service, NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.)

^b Includes both sexes.

^c Data only included from entanglement research roundups where all individuals were counted. Calculations will differ from previous years because seals were released after roundups rather than killed as in the commercial harvests.

^d Includes only seals encountered in roundups or subsistence harvests where all seals of harvestable age were counted. To achieve comparability with previous data 32 seals that were resighted (Table 9) were included with the 69 seen for the first time (Table 7) all from roundups from 8 July to 7 August (Table 7).

comparable as possible to the data from the harvest, the roundup sample can be used as samples taken with replacement. To do this, all entangled seals sighted in roundups are counted (even if they have been seen previously). Such a comparison of numbers of juvenile males encountered in commercial harvests and-entanglement research roundups is presented in Table 13.

Experimental Studies on Nearly-weaned Pups

The principal objective of this part of the 1985 entanglement studies was to determine the various sizes of trawl net in which nearly-weaned pups (approximately 14 weeks old) could become entangled. From 2-13 October 1985, large pups were captured from Little Zapadni Rookery on St. Paul Island, temporarily placed in a circular pool (5 m diameter and 1.5 m deep), and exposed to net fragments (1 m²) of various mesh sizes.

A total of 22 trials were run, with 5 pups in the pool per trial. Pups were used in one trial before being released. In each trial, 3-6 pieces of netting (all of the same mesh size) were placed in the pool, where they floated at the surface. Mesh sizes from 12-22-cm stretch mesh were tested (two trials per mesh size). If a pup became entangled in the netting for at least 30 minutes, it was scored as being entangled for the trial. Each trial lasted up to 5 hours, although a trial was terminated sooner if all pups had become entangled.

Figure 10 illustrates the mesh sizes in which pups became entangled. Being caught by the face was defined to occur when the netting became lodged anterior to the ears; netting lodged posterior to the ears was defined as being caught by neck. There was an abrupt shift from the mesh sizes in which no pups were caught to those in which all pups were caught. All mesh sizes greater than 15 cm stretch mesh entangled pups by their neck at a high rate.

Mesh sizes smaller than 20 cm are clearly a threat to pups, but are not often seen on juvenile males observed ashore (Fig. 11). The ability of pups to entangle themselves in mesh sizes 16-20 cm and larger suggests a potentially great impact on young, naive seals just after weaning. The low incidence of this mesh size observed on individuals that survive entanglement may indicate a high mortality of post-weaning seals that become entangled in marine debris.

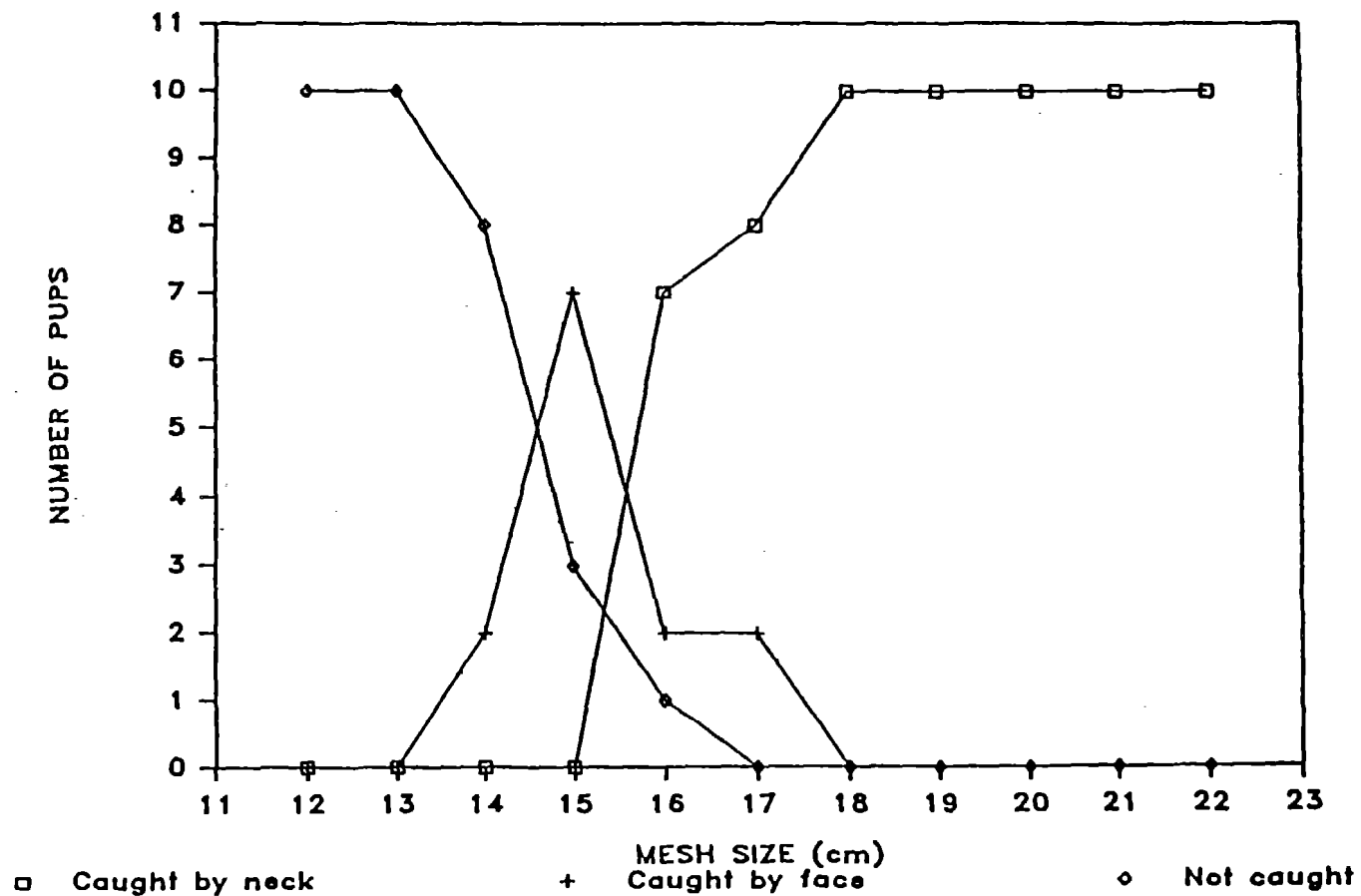


Figure 10.--Results of entanglement experiments on captive, nearly-weaned pups, Net fragments of the mesh size indicated were experimentally presented to pups.

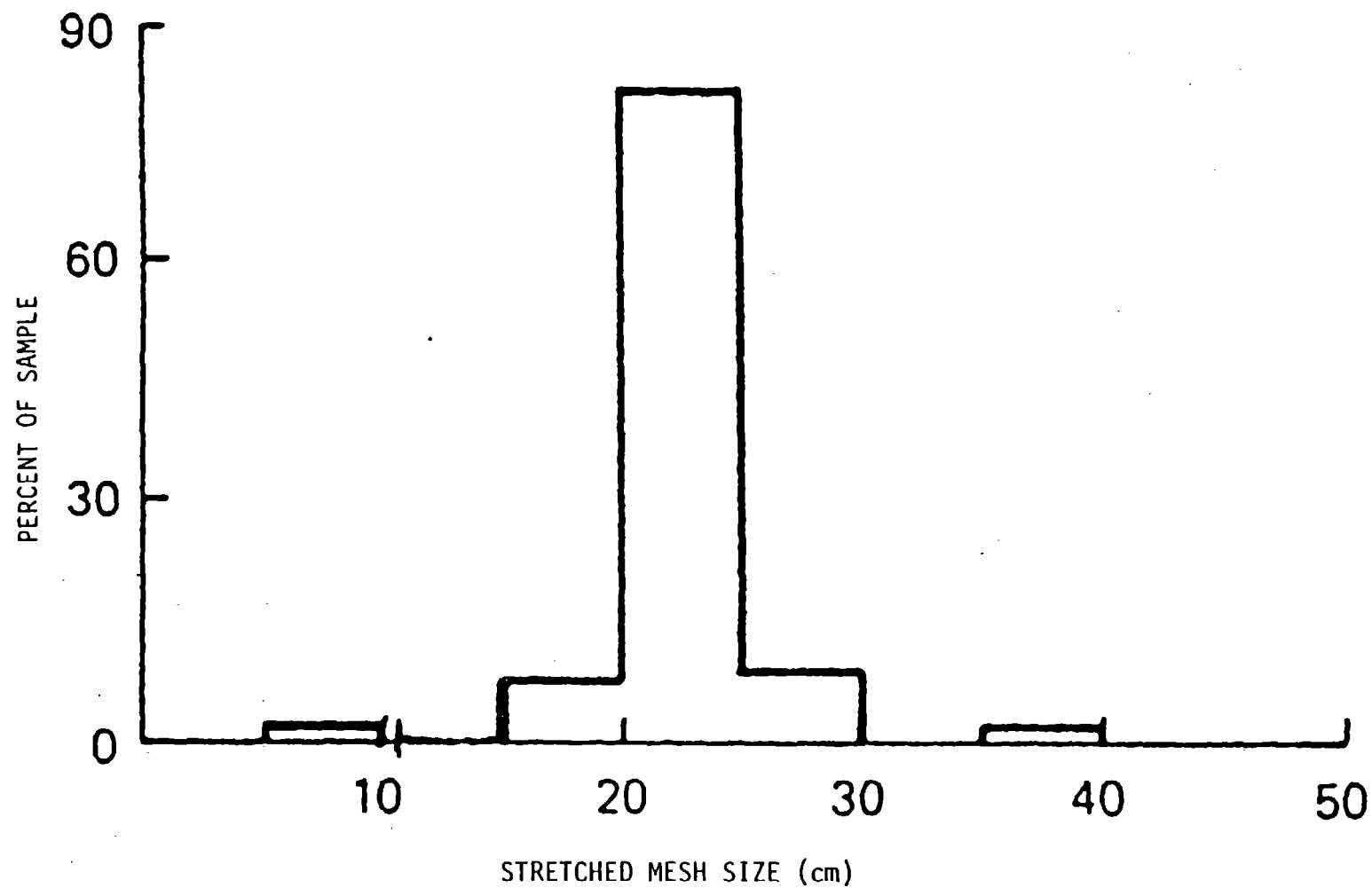


Figure 11.--Frequency distribution of mesh sizes found on juvenile males (n=58) taken in the commercial harvest on St. Paul Island, Alaska.

INCIDENCE AND IMPACT OF ENTANGLEMENT IN NETTING DEBRIS ON
NORTHERN FUR SEAL PUPS AND ADULT FEMALES, ST. PAUL ISLAND, ALASKA

by

Robert L. DeLong, Pierre Dawson, and Patrick J. Gearin

The decline of the Pribilof Islands northern fur seal population has been attributed to increased mortality due to entanglement in marine debris and has been based mainly upon studies of juvenile males (Fowler 1982, 1985). If entanglement is responsible for the population decline, females would have to be suffering substantial mortality from entanglement. However, past surveys of entanglement in adult females have indicated that fewer females than juvenile males become entangled (See "Fur Seal Entanglement Studies in 1984, St. Paul Island, Alaska" in this report; Bigg 1979). Therefore, in 1985 a series of studies was carried out on St. Paul Island between July and November to assess the incidence and effects of entanglement on adult and juvenile females and pups as follows:

1. Conduct serial surveys on sample areas to assess entanglement rates among adult females on the rookeries at St. Paul Island.
2. Assess the impact of entanglement on lactating females by experimentally entangling a group of females and comparing their attendance patterns, mortality rate, and the growth of their pups to a group of unentangled females and their pups (controls).

3. Assess the energetic cost of entanglement to adult females during foraging trips and to pups when swimming.
4. Assess the incidence of entanglement in juvenile females and pups late in the season.

A summary of these studies are included here, and a complete report is available from the National Marine Mammal Laboratory.

Surveys of Entangled Adult Females

Five to eight surveys were conducted every other day on sample areas of Tolstoi and Polovina Cliffs rookeries and on all of Lukanin rookery during July, August, and September in order to observe postpartum females using these rookeries. These surveys were necessary as postpartum females are expected ashore only about 20.0% of the time, the remainder being spent at sea feeding to maintain lactation. Survey areas were chosen where observations could be made from cliff tops without disturbing seals in the rookeries. Surveys were conducted using 8 x 40 or 10 x 50 binoculars, examining and counting all females which could be seen clearly. A total of 16 entangled females were seen on the three study sites. In addition, 12 females were observed with neck scars. Five of the 12 seals had been entangled during the past year or earlier as evidenced by the abraded guard hairs on the anterior shoulder areas. The remaining 7 seals had either been in debris and escaped or could have had small pieces of line still embedded deep in the fur or flesh creating the apparent scar around the neck.

To convert the observed incidence of entanglement to an entanglement rate, the number of pups counted or estimated on the study areas was used as a measure of the number of parturient females using the rookeries. Rates of female entanglement (excluding females which had been recently entangled) ranged from 0.06% on Lukanin rookery to 0.23% on the study areas on Tolstoi rookery (Table 14). The mean rate for the three rookeries was 0.15%.

Table 14.--Female northern fur seal entanglement on three study sites, St. Paul Island, Alaska, 1985.

| Location | Number entangled | | Number of pups ^a | Percent of entanglement ^b |
|-----------------|---------------------------|-----------------|-----------------------------|--------------------------------------|
| | White- or mixed-whiskered | Black-whiskered | | |
| Tolstoi | 10 | 2 | 5,144 | 0.23 |
| Lukanin | 1 | 2 | 4,635 | 0.06 |
| Polovina Cliffs | 0 | 1 | 1,651 | 0.06 |
| Total | 11 | 5 | 11,430 | |

^a The number of pups counted or estimated on the rookeries were used as a measure of the number of parturient females using the areas.

^b Calculated from total of actual entanglement plus those animals with evidence of having been entangled (rubs and scars).

One female which was nursing a pup at Tolstoi Rookery appeared to have become recently entangled in a piece of trawl web while feeding in the Bearing Sea during the summer. She was first seen in September with a pup in good condition.

Impacts of Entanglement on Adult Females and Their Pups

In order to assess the impact of entanglement on parturient females and their pups, an experimental study was carried out at Zapadni Reef rookery. Forty adult, newly parturient females and their pups were captured between 8 and 14 July. They were alternately assigned as experimental and control animals. Experimental females were entangled in a 200-g piece of 23-cm trawl web. The 1.4- x 0.6-m piece of web was folded twice to form a mass with an approximate 0.7- x 0.3-m dimension. The folded trawl web piece was placed over the head of a physically-restrained female by sliding the seal's head through the center meshes. Radio transmitting tags were attached with epoxy resin to the pelage on the heads of both experimental and control females, they were double-tagged with white Allflex tags (Table 15) and released with their pups back into the territory from which they were captured. The pups were weighed and marked with a bleached number in their pelage.

The attendance cycles and at-sea feeding cycles of the adult females were monitored continuously by a programmable receiver and strip chart recorder. In addition, all tag frequencies were scanned manually twice a day and the animals were observed daily between 22 July and 13 October from a 5-m high observation tower to check the condition of entangled and control seals, and to see whether the nets or radio transmitters had been lost. No attempt was made to remove the trawl web entangling the females; their survival is to be compared

Table 15.--Adult northern fur seal females double-tagged in entanglement study at Zapadni Reef Rookery, St. Paul Island, Alaska, 1985.

| Tag number ^a | Status ^b |
|-------------------------|---------------------|
| 5001 | Entangled |
| 5002 | Control |
| 5003 | Entangled |
| 5004 | Control |
| 5005 | Entangled |
| 5006 | Control |
| 5007 | Entangled |
| 5008 | Entangled |
| 5009 | Entangled |
| 5010 | Control |
| 5011 | Entangled |
| 5012 | Control |
| 5013 | Entangled |
| 5014 | Entangled |
| 5015 | Control |
| 5016 | Entangled |
| 5017 | Control |
| 5018 | Entangled |
| 5019 | Control |
| 5020 | Entangled |
| 5021 | Control |
| 5022 | Entangled |
| 5023 | Control |
| 5024 | Entangled |
| 5025 | Entangled |
| 5026 | Entangled |
| 5027 | Entangled |
| 5028 | Entangled |
| 5029 | Entangled |
| 5030 | Entangled |
| 5031 | Control |
| 5032 | Control |
| 5033 | Control |
| 5034 | Control |
| 5035 | Control |
| 5036 | Control |
| 5037 | Control |
| 5038 | Control |
| 5039 | Control |
| 5040 | Control |

^a White Allflex tags.

^b "Entangled" were entangled in about 200 g of 22 cm (stretched mesh) trawl web and radio tagged. "Controls" were radio tagged only.

with the controls during the 1986 field season. At approximately 1 month of age, pups were recaptured, weighed, and tagged with white Allflex tags; these pups were again captured in September for a final weighing.

Results of the entanglement study on adult females were as follows: 1) three females freed themselves from the nets; 2) 9 of 17 remaining experimentally entangled females did not return from the first (3), second (4), or third (2) trip to sea; 3) one control female did not return from the second or subsequent feeding trips; and 4) at-sea times for entangled females averaged about twice as long as trips for control females (Table 16).

At approximately 1 month of age, pups of entangled and control females were captured, weighed, and tagged with white Allflex tags (Appendix Table B-1) in August. These pups were again captured in September to determine average weight gain of pups in the two groups as shown below:

| | <u>11 August</u> | <u>18-28 September</u> |
|--------------|------------------|------------------------|
| Experimental | 1.20 kg (n = 12) | 2.20 (n = 7) |
| Control | 2.10 kg (n = 19) | 3.60 (n = 14) |

Eleven of 17 pups of entangled females and one pup of a control female died during the study.

It was apparent from the results that the 200 g of trawl web had created a significant encumbrance to the adult females while foraging at sea. The nine females that did not return either abandoned their pups and remained at sea or alternatively may have died at sea. By

Table 16. --Length of at-sea feeding trips (in days) for experimentally entangled and control female northern fur seals, Zapadni Reef rookery, St. Paul Island, Alaska, 10 July to 10 October 1985. A dash indicates no data.

| | Trip number | | | | | | | |
|------------------|-------------|------|------|------|-----|-----|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| <u>Entangled</u> | | | | | | | | |
| Mean | 9.9 | 12.5 | 12.7 | 15.2 | - | - | - | - |
| Std. deviation | 2.6 | 2.6 | 2.2 | 2.3 | - | - | - | - |
| n | 14 | 9 | 6 | 4 | - | - | - | - |
| <u>Control</u> | | | | | | | | |
| Mean | 5.1 | 6.8 | 6.9 | 6.8 | 7.5 | 7.5 | 7.0 | 8.2 |
| Std. deviation | 1.2 | 1.3 | 1.2 | 1.8 | 2.1 | 1.8 | 1.5 | 1.6 |
| n | 20 | 19 | 19 | 19 | 15 | 13 | 11 | 8 |

mid-October, 3 months after the females were entangled, none of the entanglements had created open wounds which could be observed visually. Thus, there was no conclusive evidence that the entanglement had caused mortality among these females during the 3 months of their entanglement. The survival and reproductive success of the entangled and control females will be assessed from observations in 1986. These observations will clarify the fate of the entangled females which did not return from feeding trips during 1985, that is, if they are not present in 1986, they probably perished as a result of the entanglement. The entangled females will be recaptured and freed from the trawl web entanglements.

The prolonged at-sea feeding cycles observed among entangled females had the effect of decreasing their pups' weight gain. As expected, the pups of the entangled females which did not return perished from starvation.

Energetic Cost of Entanglement to Northern Fur Seal Females and Pups.

Three pups were captured at St. Paul Island in mid-November 1985 and transported to Long Marine Laboratory at Santa Cruz, California, where energetic measurements on entangled and control pups will be made.

Surveys of Entanglement in Juvenile Females and Pups.

Surveys of juvenile female entanglement were planned to assess whether entanglement rates for young females were comparable to those for juvenile males. It has been generally noted that only a few young

females are entangled in marine debris during the summer fur seal breeding season. Juvenile females apparently do not begin arriving back on the rookeries and hauling grounds until August and September after the harvest and when most of the scientific survey activity has been completed. Thus, previous surveys had never been conducted specifically to assess the presence or absence of entangled females.

Pup entanglement has been known to occur, based upon anecdotal reports from the Pribilofs, but had not been systematically documented.

Between 11 September and 16 October 1985, all rookeries and hauling grounds on St. Paul Island were surveyed for the presence of entangled juvenile (black-whiskered) females and pups. Most entangled animals were captured, the nature of the entanglements were recorded, and the animals were tagged with orange Allflex tags.

During the surveys, 21 entangled juvenile females plus three with neck scars and one with an open wound encircling the neck were observed. Twelve of the 25 females were captured and tagged (Appendix Table B-2). The debris entangling the young females was as follows: Trawl web or twine (14), monofilament gillnet (3), and plastic or rubber bands (4). Attempts to translate entanglement observations into entanglement rates for juvenile females failed because of our inability to assess the total number of juvenile females on the rookeries and hauling grounds.

Although we do not know how the rates of entanglement among juvenile females compare to those for juvenile males, it was interesting to note that during this survey when 17 entangled juvenile females were recorded, a total of 28 entangled juvenile males were observed. The comparison of these figures suggests that the incidence of entanglement in juvenile females is less than that of males of the same age; however, the same result could be caused by fewer females than males of the same age returning to the islands at the same time.

The first entangled pup was seen on 12 September, roughly 1 month after the pups began going into the Bering Sea for the first time. Between 11 September and 16 October, 39 entangled pups were observed. Five pups were entangled in a single piece of orange trawl web which had become wrapped around a channel marker anchor line. Another five pups became entangled in a large piece of blue trawl web (16 cm mesh) and washed ashore at Zoltoi Sands. Two pups came ashore at Gorbatch rookery in a 500-g piece of trawl web. The remaining (29) pups were single-animal entanglements in pieces of trawl web (16), packing bands (6), rope or twine (3), cloth (2), neoprene (1), and a balloon (1).

Five of the 39 entangled pups were dead when first observed. Each of these was entangled in large pieces of trawl netting--three in the netting which became snagged on the channel marker anchor line, and one each in pieces of trawl web about 0.5 kg and greater than 1.0 kg in mass.

Twenty-two of the live entangled pups were captured and sexed; of these, 19 were weighed and tagged with orange Allflex tags (Appendix Table B-2).

Surveys of the rookeries and beaches of St. Paul Island and the beaches of the islands in the Unimak Pass area of the eastern Aleutian Islands were conducted in mid-November to look for dead entangled fur seal pups. The number of fur seal pups was quite low on St. Paul Island because roughly 50 to 70% of the pup population had already departed the island. One tagged entangled pup and one newly-entangled pup were seen on St. Paul Island. Both were in good condition and entered the water with other pups. No dead entangled pups were observed on St. Paul Island. The surveys for entangled pups on the beaches around Unimak Pass did not result in any sightings of entangled Pups.

Many tagged fur seals were observed during surveys of rookeries and hauling grounds (Appendix Table B-3).

DISEASE STUDIES, ST. PAUL ISLAND, ALASKA

by

Robert L. DeLong

Blood serum samples were collected from 300 bachelor male northern fur seals taken in the subsistence harvest on St. Paul Island. Samples are being screened for antibodies to leptospires and a series of viral pathogens. Serum samples and swabs for calcivirus isolation were taken from 37 pups from Northeast Point and Little Zapadni rookeries on 10 and 11 November, respectively. Twenty-nine of these pups were tagged with monel cattle ear tags on both front flippers (Appendix Table B-4).

FUR SEAL ENTANGLEMENT STUDIES IN 1984, ST. PAUL ISLAND, ALASKA

by

Joe Scordino, Hiroshi Kajimura, Norihisa Baba, and Akira Furuta

This section reports fur seal entanglement data collected during the second year of a 3-year cooperative U.S. - Japan study on St. Paul Island, Alaska. This portion of the cooperative study emphasizes the examination of debris entangled on fur seals observed during the 1984 harvest of subadult males. Results of the first year's studies are reported in Scordino et al. (1984). Information collected on St. Paul Island in 1984 include the type of entangling debris, the mesh sizes of entangling webbing material, pathological examinations on the type of and the degree of injury, the age and size of seals that were entangled, the incidence of scarred seals (indicative of a prior entanglement), and the returns of entangled seals tagged during the harvest in 1983. In addition, some of the entangled subadult males in the 1984 harvest were tagged and released with the debris intact. Surveys were also conducted to record sightings of entangled seals in haul-out and breeding areas and to find entangled seals that were tagged and released during 1983 and 1984. Two beach areas were also surveyed and cleared of debris for the second and third consecutive years.

From a total of 22,066 seals harvested in 1984, 87 subadult males (0.39%) were observed with entangling debris around their heads, necks, or shoulders (Appendix Table B-5). In recent years (1976-84), the incidence of entanglement has averaged about 0.42% of the subadult

males harvested. Entangled females were not observed among subadult males driven in the harvest in 1984. The incidence of entangled females in the harvest is rare; only two have been observed in the last 4 years (1981-84).

Trawl net webbing was the predominate debris found entangled on seals in the harvest and accounted for 55.0% of the entangling debris observed on seals (Table 17). Plastic packing bands were the second most frequently occurring debris, accounting for 23.0% of the entangling debris. Seventy-four percent of the trawl net fragment samples taken off the entangled seals had a mesh size greater than 20.0 cm (Table 18). The trawl webbing mesh sizes ranged from 13.5 to 28.0 cm with the 23.0-, 21.5-, and 24.0-cm mesh sizes occurring most frequently. Most entangled seals observed in the harvest were entangled in small fragments weighing less than 200.0 g and in mesh loops rather than in holes or tears in the webbing. A detailed account of entangled seals examined during the harvest is shown in Appendix Table B-6.

The severity of trauma caused by entangling debris was determined by measuring the length of open wounds along the point of entanglement (usually about the neck) and is expressed as degrees of a circle in this report. Many seals with entangling debris did not have open wounds; however, of the 33 entangled seals with wounds, 38.0% had open wounds that extended over 270° of the line of entanglement (Table 19). Of the seals entangled with debris, open wounds occurred in 40.0% of the seals in trawl nets, 21.0% of those in plastic bands, 100.0% of those in gillnets, and 38.0% of those in other debris.

Table 17. --Types of entangling debris observed on northern fur seals during the harvest and frequency of occurrence in 1984.

| Type of debris | Frequency (percent) |
|--|------------------------|
| Trawl webbing | 55 |
| Plastic packing band | 23 |
| Rope | 6 |
| Gillnet | 5 |
| String | 5 |
| Trawl webbing and plastic packing band | 2 |
| Cord used in net construction and repair | 2 |
| Plastic ring | 1 |
| Plastic object | 1 |

Table 18.--Mesh sizes of trawl webbing entangled on northern fur seals during the harvest and frequency of occurrence in 1984.

| Mesh size (cm) | Frequency (percent) |
|-------------------|------------------------|
| 10-14 | 2 |
| 15-19 | 4 |
| 20-24 | 66 |
| 25-29 | 8 |
| Undetermined | 20 |

Table 19.--Incidence of open wounds in northern fur seals during the harvest with entangling debris in 1984.

| Degree of open wound | Frequency (percent) |
|----------------------|------------------------|
| No open wound | 61 |
| 0°-90° | 7 |
| 91°-180° | 8 |
| 181°-270° | 5 |
| 271°-360° | 18 |
| Undetermined | 1 |

A comparison of the ages of entangled seals taken during studies in 1982-84 to the incidence of wounds show that the frequency of wounds increases with age (Table 20). Of entangled seals ages 5 years and older, 82.0% had open wounds while 50.0% of the 4-year-olds and 30.0% of the 3-year-old seals had open wounds.

In addition to the entangled animals, 67 seals were observed to have scars or wounds that were indicative of previous entanglement (Appendix Table B-6). Another 17 seal pelts examined in the processing plant on St. Paul Island (Appendix Table B-7) showed similar entanglement scars or bruises on the dermis of the skin (after the blubber was removed). The incidence of entanglement-scarred seals (without debris) was the same (0.39%) as the incidence of seals with entangling debris (Appendix Table B-5). These observations demonstrate that some animals can extricate themselves from entangling debris within a relatively short period of time and can survive an entanglement episode even when such entanglement causes an open wound. Four of these entanglement-scarred seals (without debris) had open wounds, two of which were 360° wounds, suggesting the animals had very recently extricated themselves from the debris. Table 21 shows harvested fur seals observed during 1982-84 with scars or bruises indicative of a previous entanglement.

To better understand the progression of skin trauma and mortality, 56 of the 87 entangled seals encountered in the 1984 harvest of subadult males were tagged and released with the debris

Table 20. --Incidence of open wounds by age of entangled northern fur seals, 1982-84^a.

| Age (year) | Sample size (number) | Incidence of wound (percent) |
|---------------|----------------------------|------------------------------------|
| 2 | 17 | 24 |
| 3 | 63 | 30 |
| 4 | 34 | 50 |
| 5+ | 17 | 82 |

^a Scordino and Fisher (1983); Scordino et al. (1984).

Table 21. --Northern fur seals observed without entangling debris, but having scars or bruises indicative of a previous entanglement, 1982-84.

| Year | Number of unentangled but scarred seals observed | Additional scarred skins observed after blubber removal | Total seals or skins observed on St. Paul with entanglement scars | Percent of harvest | Additional scarred skins observed after guard hair removal ^a | Total scarred skins ^a | Percent of harvest |
|------|---|---|---|--------------------------|--|--|--------------------------|
| 1982 | 20 | 34 | 54 | 0.22 | 37 | 91 | 0.37 |
| 1983 | 51 ^b | 33 | 85 | 0.33 | - | - | - |
| 1984 | 68 ^b | 17 | 85 | 0.39 | - | - | - |

^a Data not yet available for 1983-84.

^b Includes oversized males recorded during the harvest.

intact as in 1983 (Scordino et al. 1984) so they could be followed through time. Some of these tagged, entangled seals (tagged in 1983 and in 1984) were resighted in 1984 without their entangling debris.

Of 75 entangled or entanglement-scarred seals tagged in 1984, 18 were resighted during the same year (Appendix Table B-8); of that 18, 14 were entangled and 4 were scarred from entanglement. One seal (tag no. 574) which had a small quantity of net on its neck extricated itself from the debris within 2 days after tagging.

Twenty-five percent of the entangled seals tagged in 1983 were sighted in 1984 (Appendix Table B-9). Eighteen (19%) of these sightings were during the subadult male harvest and the remainder were sighted during the few cursory hauling ground surveys. In order to compare these returns with the return rates of unentangled seals, we reviewed similar efforts to sight tagged, unentangled, subadult males during the harvest on St. Paul Island in 1978 and 1979. Griben (1979) tagged 356 and 1,236 subadult males during the harvests in 1977 and 1978 respectively. In 1978, Griben sighted 193 (54%) of the 1977-tagged seals during intensive sighting efforts on St. Paul Island both during the harvest and during daily surveys of all haul-out areas. In 1979, the harvesting crew on St. Paul sighted 324 (26%) of the 1978-tagged seals exclusively during the harvest operation on St. Paul Island. Because all of the 1984 sightings of tagged entangled seals during the harvest were initiated by the harvesting crew as was the case in 1979, these 1979 data were determined to be more appropriate for comparison than the 1978 returns by Griben (1979) which were the

result of considerably greater resighting effort. Comparing tag returns of 'normal' subadult males in the 1979 harvest with tag returns of entangled subadult males in the 1984 harvest shows no statistical difference ($P \geq 0.95$) (Anne E. York, NMML, personal commun., 1984).

These tagging studies suggest that the mortality of entangled subadult male seals is not significantly different than that of unentangled subadult male seals over at least a one 1-year period. This finding contrasts with previous reports of an assumed short time-frame mortality in entangled seals (Fowler 1982). However, it should be noted that 50% of the 1984 returns of 1983 tagged entangled seals were seals that had extricated themselves of the previously entangling debris. The loss of debris was not considered in past assumptions on entanglement mortality and obviously would be a significant factor. Nonetheless, the returns demonstrate that an entangled seal can survive over 1 year with the debris intact similar to a "normal" unencumbered seal in spite of the trauma caused by the debris.

Seventy-five percent of the entangled seals did not have open wounds when they were tagged in 1983 and many of these still had no marks or scars when resighted in 1984, suggesting that the wounds caused by entangling debris may take over a year to develop. Nine of the 24 resighted seals had open wounds when they were tagged in 1983; 5 of these had deep 360° wounds in 1983 and still had deep 360° wounds with debris intact in 1984.

In addition to the efforts made to observe entangled seals in the harvest, specific and opportunistic surveys were conducted to determine the incidence of entangled seals in the breeding areas and haul-out areas. These surveys were conducted from mid-June until the end of October (Appendix Table B-10).

The incidence of entanglement among adult females was significantly less than that observed among subadult males (Table 22). The late-season (September-October) surveys (Appendix Table B-10) also resulted in relatively very few sightings of entangled females; however, it is very difficult to distinguish the sex of young animals using these observational techniques.

Two beach areas, a rocky boulder beach on the west side of Northeast Point and the Zolotoi Sands beach, were surveyed and cleared of debris for the second and third consecutive years, respectively. All removable pieces of net, rope, string, and plastic banding material on both beaches were collected, and samples were taken from both beaches. Totals of 30.0 kg and 40.0 kg of webbing were collected from Northeast Point and Zolotoi Sands beaches, respectively. Samples of beach survey debris (1982-84), net webbing collected off seals (1983-84), and debris other than net webbing (bands, strings, etc.) taken off seals (1981-84) were sent to Japan for examination. A separate report on these examinations will be prepared by the Japanese scientists involved in these studies.

Table 22. -- Incidence of entangled northern fur seal females during breeding area entanglement surveys in 1984.

| Date (July) | Rookery | Estimated number of females surveyed | Number of females with entangling debris | Incidence of entanglement (percent) |
|----------------|-----------------|--|--|---|
| 7 | Reef | 6,200 | 2 | 0.032 |
| 8 | Northeast Point | 3,200 | 1 | 0.031 |
| 14 | Reef | 4,000 | 1 | 0.025 |
| 15 | Northeast Point | 5,800 | 1 | 0.017 |
| 25 | Reef | 1,200 | 1 | 0.083 |
| 29 | Reef | 1,200 | 2 | 0.167 |
| | Total | 21,600 | 8 | |

BEHAVIOR AND BIOLOGY OF NORTHERN FUR SEALS, PRIBILOF ISLANDS, ALASKA

by

Roger L. Gentry, Wendy E. Roberts, and Michael E. Goebel

The research effort of the NMML Behavior and Biology Task in 1985 centered on: 1) baseline fur seal behavioral studies, 2) survival and pregnancy rates of marked females, 3) behavior of peripheral males at Staraya Artil rookery (St. George Island), 4) diving behavior of females at St. Paul Island for comparison with past St. George Island data, 5) identification of feeding areas for animals located at sea by telemetry, 6) behavioral monitoring at Kitovi rookery, St. Paul Island, 7) swim speeds of females during feeding excursions, and 8) diving behavior of adult males (a pilot study).

This report discusses the study of swim speeds and changes in female numbers and distribution at St. George Island from 1974 through 1985 (preliminary results). The tags applied to fur seals at St. George and St. Paul Islands in 1985 are summarized in Table 23.

Swim Speeds

The foraging behavior of northern fur seals has been studied for 10 years in an attempt to relate changes in food resources to population trends of northern fur seals. This correlation was Proposed in the document that established the St. George Island project (Anon. 1973). Mechanical time-depth recorders (TDRs) were devised to measure foraging effort in a complex and inexpensive way. The behavior of foraging seals has been reported elsewhere (Gentry et al. 1986; Gentry and Kooyman

Table 23. --Tags applied to northern fur seals on St. George and St. Paul Islands, Alaska, in 1985 for studies of behavior.^a

| Type and color of tag | Tag number | Age-sex class | Number of seals tagged | Rookery |
|-----------------------|---|---------------|------------------------|----------------------------|
| White Monel | X501-X506 X510-X511 | Adult males | 4 | Staraya Artil ^b |
| Pink Roto | 853-854 | Female pup | 1 | Kitovi ^b |
| | 855-862 | Adult females | 4 | Kitovi |
| White Riese | 2801-2815 | Adult females | 15 | Kitovi |
| | 2816-2817, 2819 | Female pups | 3 | Kitovi |
| | 2818 | Male pup | 1 | Kitovi |
| Green Roto | 808, 810 | Male pups | 2 | Kitovi |
| | 811 | Female pup | 1 | Kitovi |
| Yellow Riese | 5922-5926, 5928-5929, 5932-5934, 5936-5940 | Male pups | 15 | Kitovi |
| | 5921, 5927, 5930-5931, 5935 | Female pups | 5 | Kitovi |
| White Allflex | 5082-5084, ^c 5201-5236 | Adult females | 37 | Kitovi |

a All seals were tagged on the trailing edges of both front flippers near the hair line.

b Staraya Artil is located on St. George Island; Kitovi is on St. Paul Island.

c White Allflex 5084 is a retag of yellow Riese 5084.

1986). The existing data provide a baseline for comparisons of foraging effort if the seal population decline resumes at its former level, or if food availability declines.

Several major questions about fur seal pelagic behavior arose from these past investigations (Gentry and Kooyman 1986). For example:

- 1) How far do fur seals forage from the islands? 2) How far and how fast do they move between feeding bouts (when they are known to be active)?
- 3) How does swim speed vary with depth? 4) Do seals catch prey by burst swimming?; 5) At what angle relative to the surface do fur seals descend and ascend from feeding dives? 6) Do swim speed and distance traveled on a feeding trip vary with body size (or with age because body size increases with age)?

To address these questions, a contract was established with Micromonitors^{1/} (Sunnyvale, California) to provide microprocessors (MPs) that sample swim velocity and depth over time. velocity was measured with a small paddle-wheel device attached to the side of the waterproof MP housing. Depth was monitored with an electronic pressure transducer in the rear wall of the MP. The MP recorded the time hourly, the start and maximum depth of each dive, the velocity at the surface once every 4 minutes, and the velocity during diving once every 15 seconds. The MP had 4,000 bytes of memory on nonvolatile chips. The memory was dumped to a minicomputer by way of a modem after the instrument was retrieved from a seal. The units, which weighed about 0.75 kg, were attached to female fur seals by nylon harnesses designed for use with conventional TDRs.

1/ Reference to trade names does not imply endorsement by the National Marine Fisheries Services, NOAA.

Seven deployments of MP-carrying females were made in July and August using two MP units. One unit was programmed to record swim velocity until 10 m depth was attained, and to then record maximum depth. The other MP unit was programmed to record swim velocity every 15 seconds during diving, and maximum depth of dives greater than 10 m in depth. Because of a malfunction in one unit, only one complete and two partial records were obtained of swim velocity at the surface; four records were obtained of swim velocity during dives.

The durations of trips to sea were slightly longer for females carrying MP units than for uninstrumented animals, but they were not longer than for females carrying conventional TDRs. Unlike deployments with TDRs, females carrying MP units did not consistently gain weight on feeding excursions. In fact, four females lost weight while two gained weight. For this reason, MP units were not placed on females that weighed less than 37 kg.

The MP data are presently being analyzed. Empirically, it appears that the maximum swim velocity attained during deep dives was about 3.5 m/second (12.6 m/hour). Swim speed during dives varied, but no brief bursts of high-speed swimming, suggesting prey pursuit, were seen. Since swim speeds were not measured for the smallest females (26-36 kg), the correlation of swim speed with size (age) will remain incomplete. All distance estimates will be made by summing the products of velocity (x) sampling interval for all data points. Descent and ascent angles will be estimated from calculating the sine of an acute angle of a right triangle in which the vertical distance (depth) is known, and the hypotenuse is the sum of velocity readings (x) sampling interval.

Changes in the Adult Female Population

At the inception of the St. George Island program, we anticipated that the female population would change in size and perhaps in distribution during the 15-year study period. To measure these changes, grids were painted on two study sites with intersections every 10 m. The Zapadni grid measured 100 m x 40 m, and the grid at East Reef measured 100 m x 30 m. Maps of these grid systems were duplicated on standard-size grid paper with a scale of 1 inch = 10 m. Each day of each reproductive season (about 15 June through 1 August) a map was drawn depicting as closely as possible the shape, size, and location of each female and pup group. The number of animals in each group was recorded on the map; sampling occurred at around 1100 hours each day. Maps are available for both sites from 1974 through 1984, and for East Reef only in 1985.

Analysis of these maps is now under way. Preliminary analysis showed that the population on shore (usually about 1/5 of the total number of females using an area) peaked from 7 through 14 July. This report summarizes preliminary analysis of maps for the East Reef rookery made from 7 through 14 July for the years 1975-84. These are the most consistent data available because they were collected by only two observers (J. M. Francis, 1975-80; M. E. Goebel, 1981-84). Single females were deleted from all data analysis because observers differed in whether they recorded area occupied by such females. Therefore, reported census values will be somewhat lower than actual counts of females.

The maps were reduced by digitizing images using a video camera and a computer program called Image Measure. To use this program a technician positioned a moveable cursor on a group drawn on the digitized map, and the computer calculated the area and the x-y coordinates of the group center. The technician then typed in the number of females in that group. Thus, a file was created with data for each day to give area, numbers, and x-y coordinates of each female group.

The data were analyzed by collating files using the statistical package MINITAB. A total census and a total area occupied were calculated for each day by summing the results for each group. These daily totals were used to calculate a daily density value (females/m²). Yearly density, area, and census values were taken as the average of the eight daily values.

Roth the total number of animals counted and the areas occupied by these animals declined from 1975 through 1984 (Fig. 12). The group sizes changed from a few large groups to many small groups in this period (e.g., see Figs. 8a and 8b in Gentry et al. 1980).

The extent of the decline in female numbers and area occupied closely mirrors the pup estimates for St. Paul Island made in the same years (Fig. 12; note that no estimates exist for 1977 and 1978). The pairwise correlations among these three parameters were excellent (area versus number, $r = 0.99$; area versus St. Paul pups, $r = 0.94$; number versus St. Paul pups, $r = 0.93$). Thus, the East Reef rookery changes occurred in close parallel with the St. Paul Island pup production during this 10-year period.

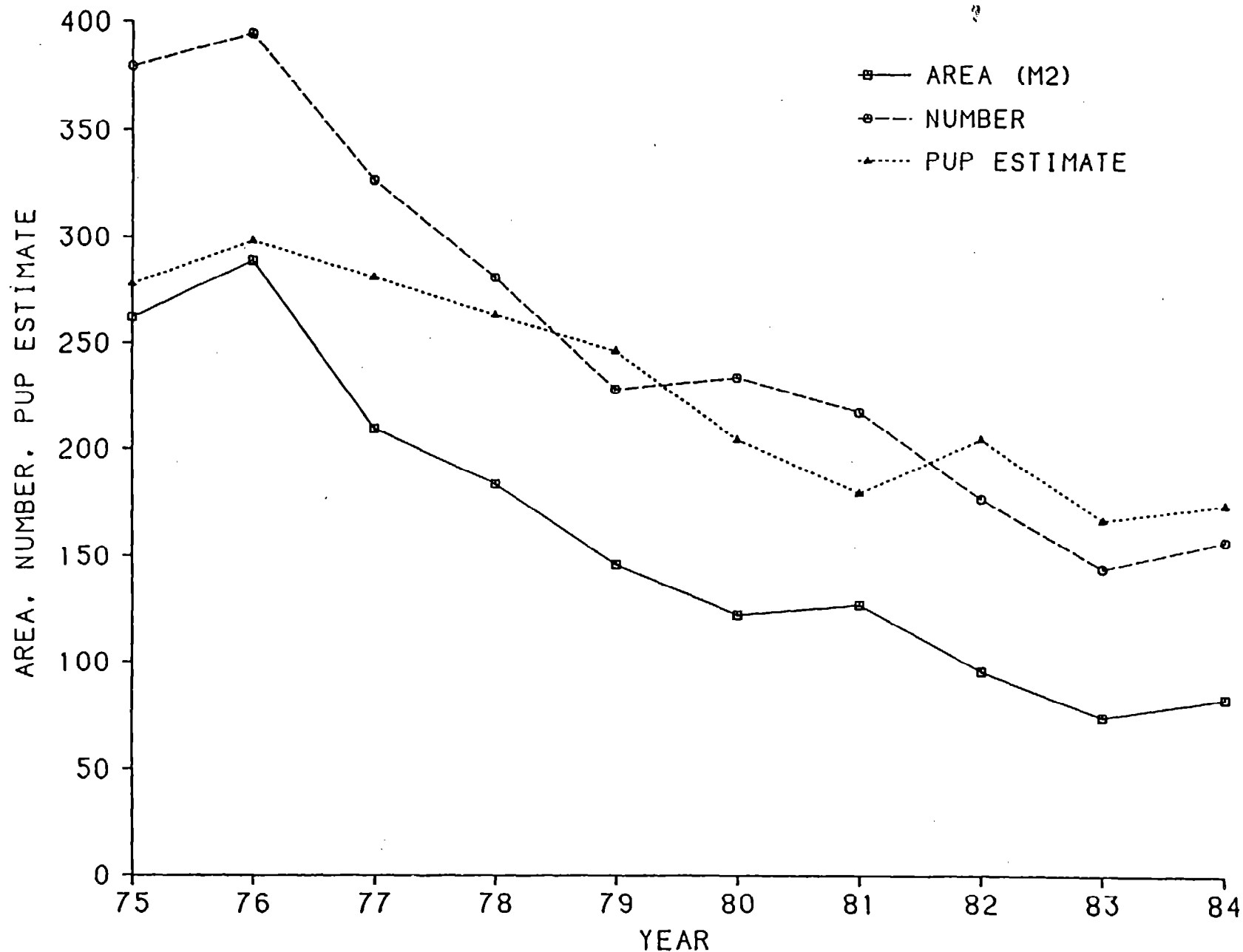


Figure 12.---Changes in the number and area occupied by adult females at East Reef rookery, St. George Island, Alaska, and estimates of pups born at St. Paul Island, Alaska, over a 10-year period.

The data show that intragroup density of females did not decline as population size declined; area and numbers of seals remained closely correlated through the study period. This correlation is seen best by plotting area occupied against numbers of seals in the same years (Fig. 13)--a virtually straight-line result. When the annual density values are plotted by year, density appears to have increased with time (Fig. 14). The two ends of the graph, 1975 and 1984, are statistically different from each other ($t = p < 0.002$). Table 24 lists the values used in the statistical analysis. The conclusion from this analysis is that if intragroup density varies with population size it varies inversely.

The East Reef fur seal population has changed relatively less than other rookeries on St. George Island since 1974 (Gentry and Francis 1981). Since the changes at East Reef closely correlate with pup production at St. Paul Island, other St. George Island rookeries have apparently changed relatively more than those on St. Paul Island.

Intragroup density is undoubtedly under behavioral control of individual females. Spacing among individuals is enforced by threats and other aggression, and by movement out of high density (frequent aggression) areas. Since the spacing between neighbors is controlled by behavioral tendencies of individuals, our observation that intragroup density is relatively stable is the expected result.

The apparent increase in intragroup density from 1975 through 1984 may be real. The male population increased as the female population was decreasing and changing from a few large groups to many small ones. The increasing numbers of males may have had more effect on the density in small female groups than on large ones, thus increasing density over

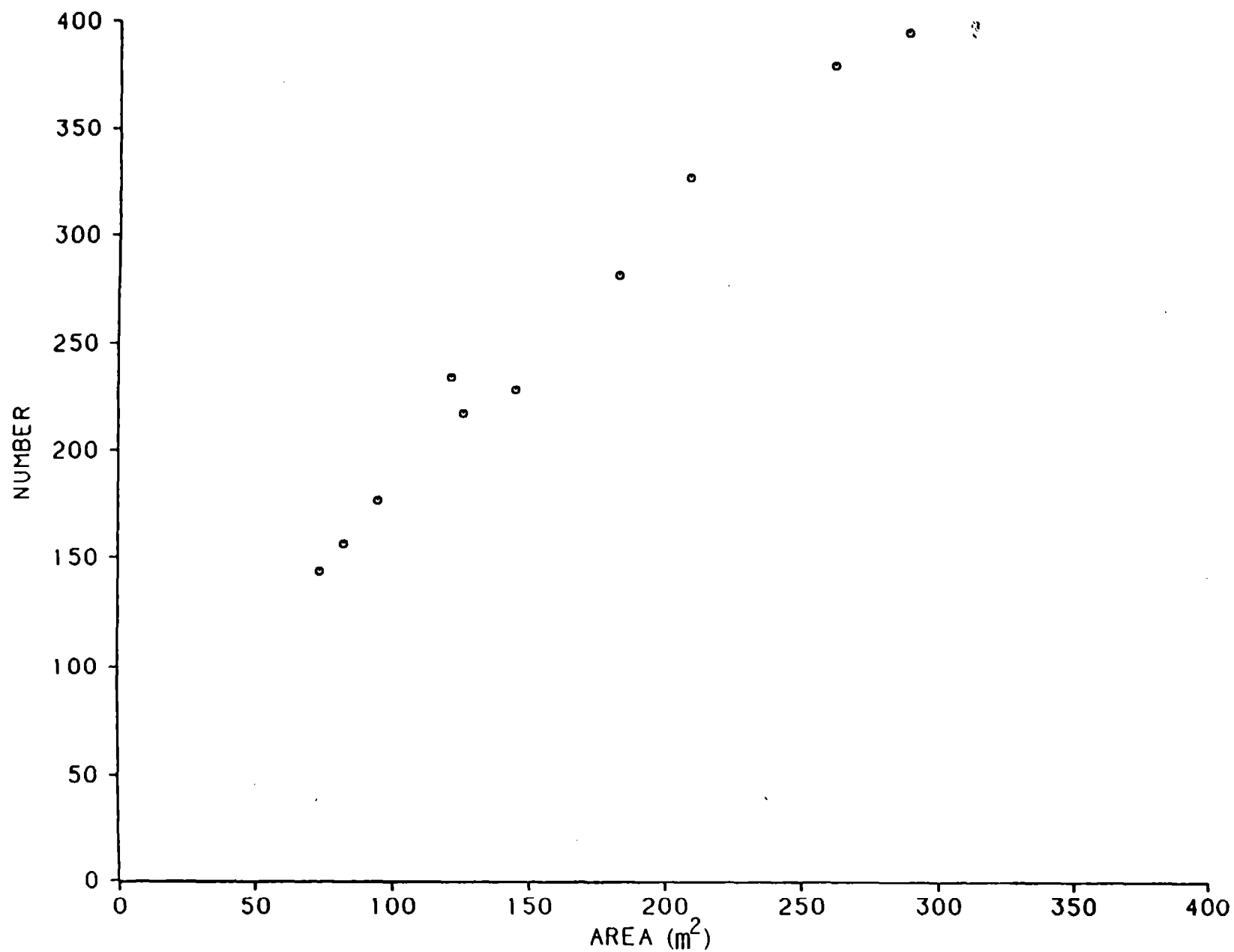


Figure 13.--Relationships between the number and the area occupied by adult females at East Reef rookery, St. George Island, Alaska, over a 10-year period (1975-84).

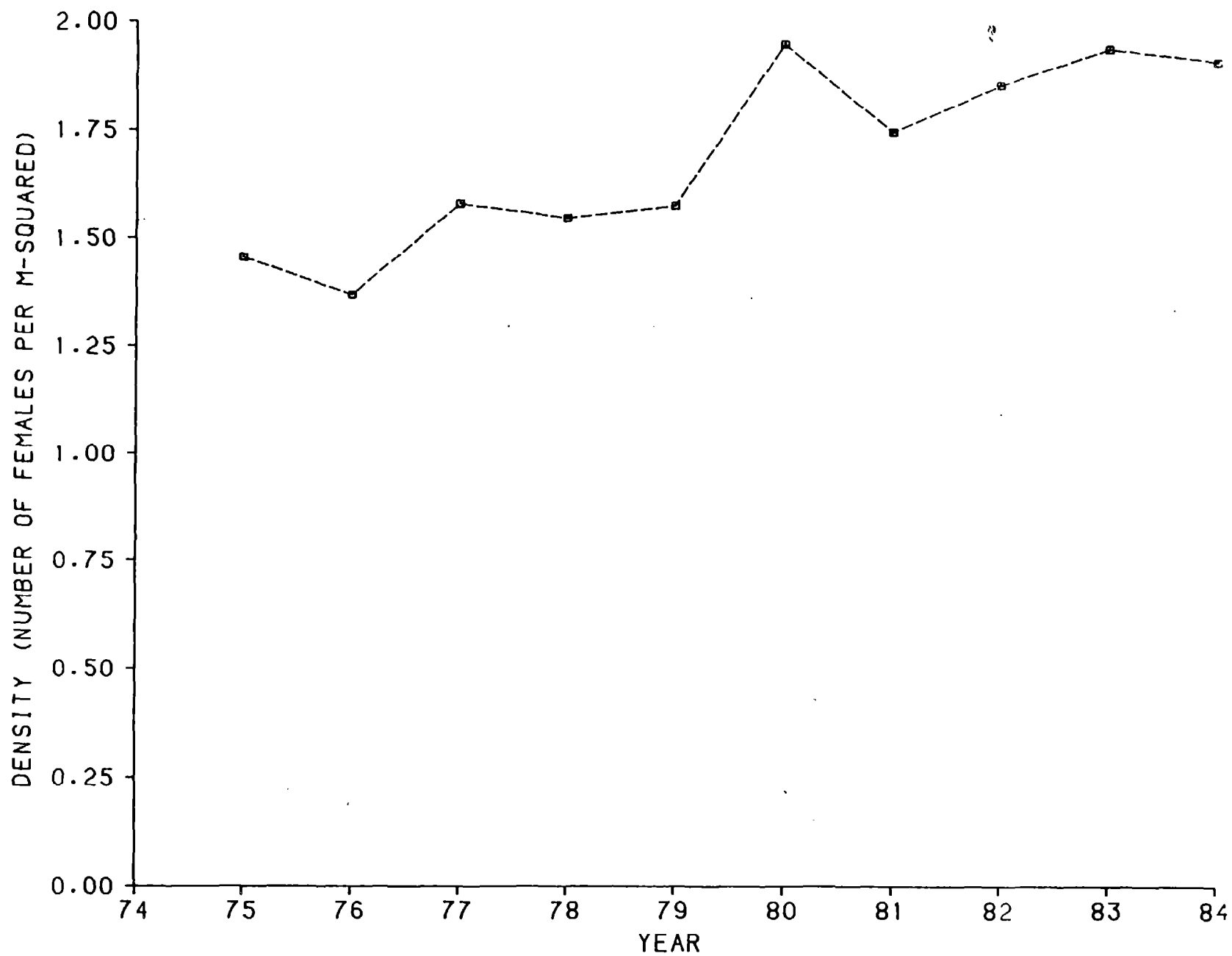


Figure 14.--Changes In the intragroup densities of adult female groups at East Reef rookery, St. George. Island, Alaska, over a 10-year period.

Table 24.--Differences in the abundance of northern fur seal female population at East Reef rookery, St. George Island, Alaska, in 1975 and 1984.

| | 1975 | | 1984 | |
|-----------------------------------|--------|-------|--------|-------|
| | Mean | S.D. | Mean | S.D. |
| Area occupied (m ²) | 262.00 | 26.00 | 83.00 | 11.60 |
| Number of females | 379.00 | 38.40 | 156.00 | 7.10 |
| Density (females/m ²) | 1.46 | 0.16 | 1.91 | 0.30 |

S.D. = Standard deviation

years. This hypothesis can be tested by examining separately the densities of same size groups over the 10-year period. Females tend to avoid contact with males by forming groups with other females. If male avoidance was the only factor affecting female behavior, then we would have expected to see smaller numbers of large female groups form as the female numbers declined. Our observation that large numbers of small female groups were formed does fit the hypothesis that female density is balanced between breeding as close to preferred sites as possible (Gentry et al. 1980) and remaining within female groups.

The apparent increase in intragroup density may be an artifact. The two individual observers recorded single females differently, and may have judged group size differently. Furthermore, the size of small groups that do not cross grid lines is more difficult to estimate on maps than the size of large groups that cross several lines. Since the number of small groups increased and large groups decreased through the years, this bias may have been progressive. Similar changes in intragroup density will be examined using Zapadni data which were collected by at least seven different observers.

Density of female groups is an important issue in fur seal management. The assumption of density-dependent mortality underlay the abortive 1956-68 herd reduction program. Density has different meanings depending on the unit of area considered. As the herd size declines, density at sea declines, but because of the behavioral tendencies of individuals, density within groups on land during the breeding season does not decline and may even increase. The importance of this

difference for management is that density cannot be considered a unitary concept in searching for causes of mortality. Causes of mortality that are associated with social processes, such as death by trauma, communicable diseases, or stress from social interactions, may not vary directly with herd size.

NORTHERN FUR SEAL SURVEY, BOGOSLOF ISLAND, ALASKA, AND

PELAGIC INVESTIGATIONS, BERING SEA

by

Thomas R. Loughlin, George A. Antonelis, Jr.,

Michael Perez, and Robert v. Miller

The Bering Sea Task of the Pinniped program conducted research on fur seals in three major categories: pelagic collection of fur seals for diet information, assessment of the colony at Bogoslof Island, and radio-tracking of females to determine feeding locations. Results from the first two categories are presented below; results of radio-tracking studies are presented in the following chapter.

Feeding Habits Study

In the southeast Bering Sea the consumption of finfish by marine mammals has the potential impact of commercial fishing on marine mammal stocks and their prey, and the consumption of common food items by marine fish are issues to be considered during the development of fishery management plans. The primary objective of this study was to compare the species composition and relative abundance of fish found in northern fur seal stomachs and marine fish stomachs to the species composition and relative abundance of fish in the watercolumn.

Methods

The NOAA ship Miller Freeman was used as the investigative vessel from 4 August 1985 to 23 August 1985. Observations and collection activities occurred within 100 nautical miles (nmi) of the Pribilof Islands, Alaska.

Fur seals were collected in predetermined sampling areas where they were presumed to be feeding (Fig. 15). The date, time, location (latitude and longitude), water temperature, and water depth were recorded immediately after each seal was collected.

Fur seals taken at sea were returned to the ship for processing within 1 hour after collection. In addition to recording each animal's standard morphometric measurements and total weight, and after removing the digestive tract for food habit analysis, a variety of other samples were collected to maximize the amount of biological information collected. The canine teeth and reproductive organs were collected for the determination of age and reproductive status, respectively. Blood samples of 25 cc were taken for disease and reproductive hormone studies: pituitary glands were collected for the development of a reproductive hormone assay technique; and rectal swabs were placed in culture media for eventual screening for viral diseases.

Sampling for groundfish was done with an 83/112 eastern bottom trawl (with roller gear when needed); midwater fish were sampled with a Diamond midwater trawl and a Marinovich herring trawl. Fish sampling was done in areas which coincided with the collection or occurrence of fur seals. Nocturnal and evening fish sampling was conducted throughout most of the cruise; however, daytime fishing was conducted at times when inclement weather conditions prohibited collection of fur seals. Tows were generally 30 minutes in duration, and trawling speed was approximately 3 nmi/hour. No tows were made until the seal collection party returned to the ship.

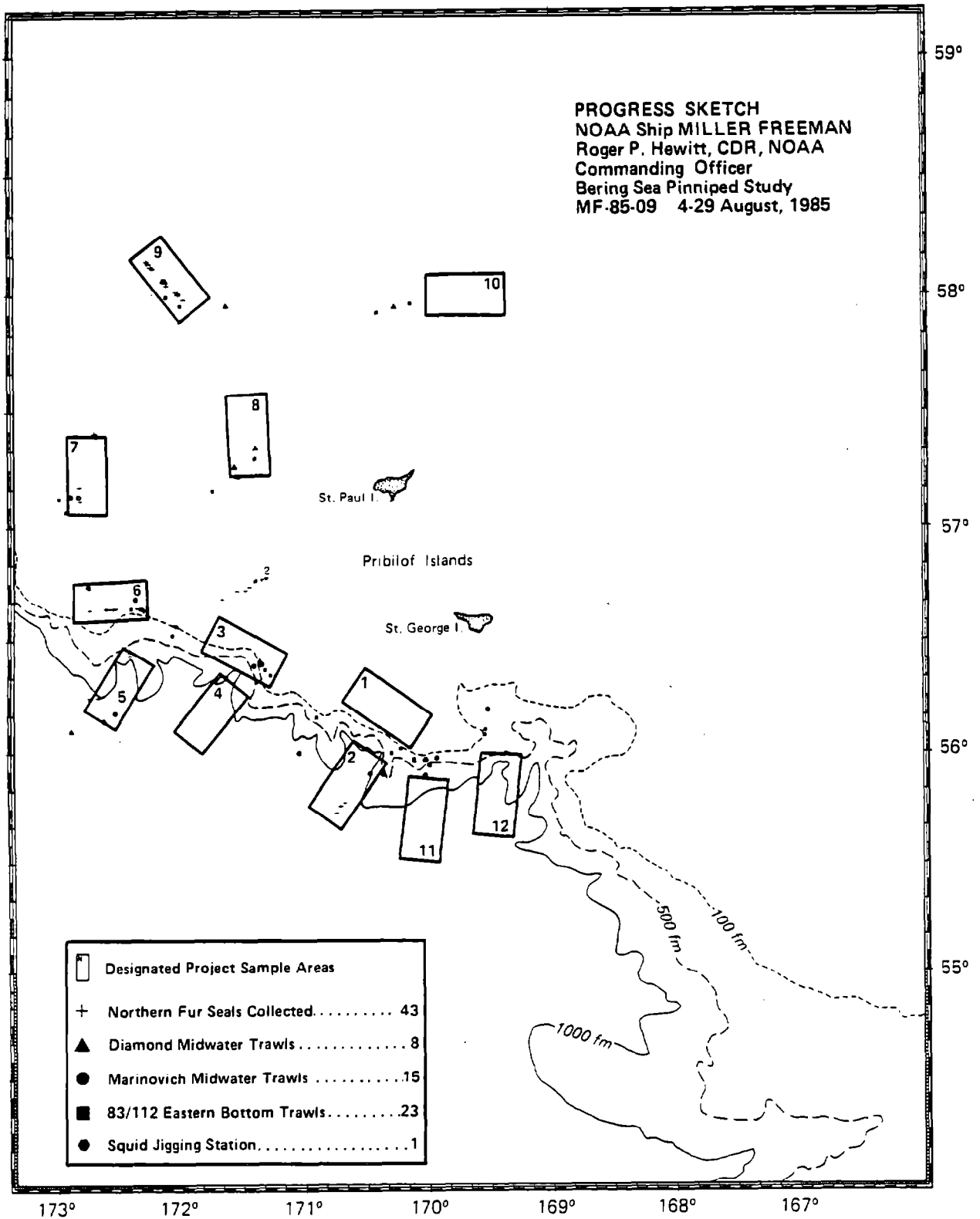


Figure 15.--collection areas for northern fur seals used on the 1985 of the NOAA ship Miller Freeman.

Results

A total of 43 fur seals were collected in the waters adjacent to the Pribilof Islands from 6 to 15 August. The collection date, time, location, depth, and number are shown in Table 25.

A total of 23 midwater tows and 23 bottom tows were completed. Table 26 shows the total weight caught per species and the number of fish stomach samples collected by species. The total weight caught during the cruise was 36,403.4 lb and the total number of fish stomachs collected was 1,172. Selected whole fish and squid specimens were retained and frozen for NMML energetic studies, fish otolith and squid beak collections, and virology studies.

Approximately 195 specimens were retained for energetic studies, 48 specimens for virology studies, and 284 specimens for the otolith examinations. The cephalopods and a subsample of the fish collected on this cruise will also be used for several other research projects at the NMML, including: 1) Northern fur seal energetics studies, which rely on fresh frozen specimens for the determination of caloric energy value of the prey; 2) An ongoing prey species identification program, which maintains a collection of fish otoliths and cephalopod beaks that are frequently used as a primary means of marine mammal prey identification. Otoliths and beaks are also used to estimate the size of a specific prey when a sufficient number of specimens are available; and 3) Studies of northern fur seals where selected fish species are examined as potential vectors of viral diseases.

Table 25.--Date, time, waterdepth, surface temperature, and location of northern fur seals (Callorhinus ursinus) collected during the research cruise of the NOAA ship Miller Freeman, 6-16 August 1985. A dash indicates no data.

| Date (Aug.) | Time | Depth (m) | Temp. (°C) | Sample area ^a | Latitude | Longitude | Seal number |
|----------------|-------|--------------|---------------|-----------------------------|----------|-----------|------------------|
| 06 | 15:15 | 3073 | 9.9 | 2 | 55°43' | 170°44' | 1 |
| 06 | 15:38 | 3018 | 9.9 | 2 | 55°45' | 170°43' | 2 |
| 06 | 15:44 | 3000 | 10.3 | 2 | 55°45' | 170°42' | 3 |
| 06 | 16:11 | 2972 | 10.3 | 2 | 55°46' | 170°41' | 4 |
| 10 | 18:27 | 115 | 10.4 | 5 | 56°40' | 171°39' | 5 |
| 10 | 19:35 | 122 | 9.4 | 5 | 56°42' | 171°32' | 6 |
| 10 | 20:24 | 123 | 9.5 | 5 | 56°43' | 171°28' | 7 |
| 10 | 20:46 | 123 | 9.5 | 5 | 56°44' | 171°26' | 8 |
| 10 | 21:24 | 123 | 9.7 | 5 | 56°46' | 171°20' | 9 |
| 10 | 21:45 | 121 | 9.7 | 5 | 56°46' | 171°18' | 10 |
| 10 | 21:55 | 121 | 9.7 | 5 | 56°46' | 171°17' | 11, 12 |
| 12 | 08:41 | 1417 | 10.1 | 5 | 56°26' | 172°23' | 13 |
| 12 | 08:51 | 1555 | 10.1 | 5 | 56°25' | 172°24' | 14 |
| 12 | 09:21 | 2285 | 10.1 | 5 | 56°23' | 172°27' | N/R ^b |
| 12 | 11:04 | 2325 | 9.5 | 5 | 56°14' | 172°39' | 15 |
| 12 | 13:00 | 2560 | - | 5 | 56°14' | 172°43' | 16 |
| 12 | 19:30 | 136 | 10.6 | 6 | 56°37' | 172°43' | 17 |
| 12 | 20:30 | 142 | 10.6 | 6 | 56°38' | 172°35' | 18 |
| 12 | 20:49 | 142 | 12.6 | 6 | 56°38' | 172°35' | 19 |
| 12 | 21:06 | 150 | 12.6 | 6 | 56°38' | 172°32' | 20 |
| 12 | 21:18 | 163 | 12.6 | 6 | 56°38' | 172°31' | 21 |
| 12 | 21:26 | 165 | 11.4 | 6 | 56°38' | 172°30' | 22 |
| 12 | 22:19 | 159 | 11.4 | 6 | 56°38' | 172°20' | 23 |
| 12 | 22:30 | 166 | 11.3 | 6 | 56°37' | 172°18' | 24 |
| 12 | 22:44 | 154 | 11.3 | 6 | 56°38' | 172°17' | 25 |
| 12 | 22:53 | 159 | 11.3 | 6 | 56°37' | 172°17' | 26 |
| 13 | 09:04 | 121 | 10.3 | 7 | 57°06' | 172°48' | 27 |
| 13 | 09:44 | 119 | 10.3 | 7 | 57°10' | 172°48' | 28 |
| 13 | 11:46 | 119 | - | 7 | 57°18' | 172°48' | N/R ^b |
| 13 | 13:30 | 123 | 10.2 | 7 | 57°24' | 172°41' | 29 |
| 13 | 13:45 | 123 | 10.2 | 7 | 57°24' | 172°41' | 30 |
| 13 | 14:03 | 121 | - | 7 | 57°24' | 172°39' | 31 |
| 13 | 14:11 | 121 | - | 7 | 57°24' | 172°39' | 32 |
| 13 | 19:52 | 106 | 10.6 | 8 | 57°13' | 171°31' | 33 |
| 16 | 19:14 | 112 | 9.5 | 9 | 58°08' | 172°15' | 34 |
| 16 | 19:26 | 112 | 9.5 | 9 | 58°08' | 172°15' | 35 |
| 16 | 19:59 | 112 | 10.8 | 9 | 58°07' | 172°13' | 36 |
| 16 | 20:05 | 112 | 10.8 | 9 | 58°07' | 172°12' | 37 |
| 16 | 21:07 | 112 | 9.6 | 9 | 58°02' | 172°05' | 38 |
| 16 | 21:47 | 112 | 9.6 | 9 | 58°01' | 172°01' | 39 |

Table 25.-Continued.

| Date (Aug.) | Time | Depth (m) | Temp. (°C) | Sample area ^a | Latitude | Longitude | Seal number |
|----------------|-------|--------------|---------------|-----------------------------|----------|-----------|----------------|
| 16 | 21:58 | 108 | 9.6 | 9 | 58°00' | 172°00' | 40 |
| 16 | 22:08 | 108 | 9.6 | 9 | 58°00' | 172°00' | 41 |
| 16 | 22:16 | 108 | 9.6 | 9 | 58°00' | 172°00' | 42 |
| 16 | 22:51 | 108 | - | 9 | 57°58' | 172°57' | 43 |

^a See Figure 15.

^b N/R = Seal taken, but not recovered from water.

Table 26.--Summary of catch weight (in pounds) and stomach collections by species. A dash indicates no data.

| Species | Total weight (lb) | Number of fish stomachs |
|---|-------------------|-------------------------|
| Pacific cod, <u>Gadus macrocephalus</u> | 3,780.9 | 228 |
| Flathead sole, <u>Hippoglossoides elassodon</u> | 740.5 | 250 |
| Arrowtooth flounder, <u>Atheresthes stomias</u> | 1,695.0 | 209 |
| Yellowfin sole, <u>Limanda aspera</u> | 664.5 | 39 |
| Greenland turbot, <u>Reinhardtius hippoglossoides</u> | 123.5 | 4 |
| Pacific halibut, <u>Hippoglossus stenolepis</u> | 506.3 | 26 |
| Sablefish, <u>Anoplopoma fimbria</u> | 221.3 | 7 |
| Walleye pollock, <u>Theragra chalcogramma</u> | 20,994.0 | 409 |
| Rockfish | 1,808.5 | - |
| Sculpins | 700.1 | - |
| Miscellaneous fish | 2,847.6 | - |
| Invertebrates | 1,914.0 | - |
| Crabs | <u>407.2</u> | <u>-</u> |
| Totals | 36,403.4 | 1,172 |

Conclusion

Weather conditions did not limit fishing operations; however, the collection of seals was frequently limited by inclement weather. During the cruise, there were only 33.5 hours of good weather for collecting seals. However, the data from the 43 fur seals collected should yield sufficient information to allow for characterization and historical comparison of fur seal diet. The completion of numerous secondary objectives, such as the assessment of the northern fur seal population on Bogoslof Island, the marine mammal survey in the waters adjacent to the Pribilof Islands, the collection of samples for specific biological studies on the northern fur seal, and the collection of fish and cephalopods for food habit and energetic studies, combine to produce data that will be useful in ongoing and future fur seal studies. Detailed reports on this research are being prepared.

Assessment of Fur Seals on Bogoslof Island

On 18 August, the NCAA ship Miller Freeman traveled to Bogoslof Island to conduct population studies. A field party consisting of six scientific personnel and three ship crew members landed on the island and counted a total of 112 northern fur seals. Most of the animals were located in the rocky boulder area near the southeast corner of Kenyon Dome, while three to five adult males were located on the level grassy area to the east of the main concentration of animals. The sex and approximate age composition of the fur seals present on the island were as follows:

27 adult males (>5 years of age),

39 bachelor males (2-5 years of age),

37 females (at least 50% >6 years of age (white-whiskered)), and 9 pups of the year.

Eighty seals were herded out of the boulders and onto the adjacent grassy area for tagging. In addition to double-tagging as many fur seals as possible with blue Riese-tags, those animals that had lost tags from a previous tag application were retagged. A total of 16 females and 9 subadult males were tagged (Table 27), and the remaining 55 males were released because they were too large to safely restrain and tag.

Five previously tagged fur seals were observed (Table 28). Four (3 females and 1 male) were originally tagged with blue Riese-tags on 11 August 1983 at Bogoslof Island. One female was originally tagged on the left foreflipper (silver Monel tag OM7719) on Medney Island, USSR, as a pup in 1976, and was subsequently tagged in the right foreflipper on Bogoslof Island in 1983 with a blue Riese-tag (2008). Since the blue Riese-tag was not attached during our observation of this animal, we attached another blue Riese-tag (2040) to the right foreflipper. Tag losses were also observed on two other females, and replacement blue Riese-tags were applied (Table 27).

All tags applied in 1983 and resighted on fur seals in 1985 had changed in color from blue to green. This was also true for a "blue" Riese-tag (2020) which was found in the grassy area near the tagging site.

Nine pups were counted in the boulder area; however, more may have been present but went undetected because of their location in caves under the rocky substrate. The pups were not tagged because they were inaccessible in crevasses between boulders.

Other marine mammal sightings at Bogoslof Island included a pod of four killer whales (one large male and three relatively smaller individuals). The northern sea lions on the island were either near the shoreline (mostly mothers and pups) or in the water (not on rookery or haul-out areas), which made it impossible to estimate their numbers.

Table 27. -Northern fur seals double-tagged on Bogoslof Island, Alaska,
18 August 1985. A dash indicates no data.

| Tag number ^a | Sex | Status ^b | Remarks |
|-------------------------|-----|---------------------|--|
| 2040 | F | WW | Right tag only; left tag, silver Monel OM719 - USSR |
| 2041 | M | B | |
| 2042 | F | - | |
| 2043 | F | - | |
| 2044 | F | WW | Left tag only; right tag blue- Riese 2009 |
| 2045 | F | WW | Left tag only; right tag blue- Riese 2020 |
| 2046 | F | - | |
| 2047 | M | B | |
| 2048 | F | - | |
| 2049 | F | - | |
| 2050 | F | - | |
| 2051 | F | - | |
| 2052 | M | B | |
| 2053 | F | - | |
| 2054 | M | B | |
| 2055 | F | - | |
| 2056 | F | B & WW | |
| 2057 | M | B | |
| 2058 | F | B & WW | |
| 2059 | M | B | |
| 2060 | F | B & WW | |
| 2061 | F | B & WW | |
| 2062 | M | B | |
| 2063 | M | B | |
| 2064 | M | B | |
| 2065 | M | B | |

^a Blue Riese-Tags.

^b B = Bachelor.

WW = White whiskers.

B & WW = Black and white whiskers.

Table 28. -Northern fur seal tag resights on Bogoslof Island, Alaska,
18 August 1985.

| Tag type | <u>Tag number</u> Left/Right | Sex | Island of tagging | Date of tagging | Age at time of tagging |
|--------------|---------------------------------|-----|-------------------------|-----------------------|------------------------------|
| Blue Riese | 2001/2001 | F | Bogoslof | 11 Aug. 83 | >6 years |
| Silver Monel | QM7719/Lost | F | Medney | 1976 | pup |
| Blue Riese | Lost/2009 | F | Bogoslof | 11 Aug. 83 | >6 years |
| Blue Riese | 2026/2026 | F | Bogoslof | 11 Aug. 83 | >6 years |
| Blue Riese | 2031/2031 | M | Bogoslof | 11 Aug. 83 | 2-5 years |

RADIO-TRACKING STUDIES, ST. PAUL ISLAND, ALASKA**by**

John L. Bengtson, Richard L. Merrick, and Thomas R. Loughlin

The northern fur seal population of the Pribilof Islands has been experiencing a decline of about 6.5% per year. The reasons for the decline are not specifically known, but entanglement in debris, changes in reproductive vital rates, competition with commercial fisheries for common fish resources, and other potential causes have been postulated. The objectives of this research project were to assess the interaction of commercial fisheries and female fur seals while at sea on feeding trips and to determine the locations of feeding sites. It has already been established that fur seals consume food items similar to those taken in commercial fisheries. The next logical steps were to determine if fur seals feed in areas of commercial fishing activity (thus competing for the same resource spatially and temporally) and to assess the overlap in their feeding locations with areas of planned oil exploration.

The primary interest in 1985 was to determine the location of feeding activity and the general pattern of movements to and from the feeding location by female fur seals. Emphasis during 1984 was to provide a delineation of the movement patterns and other information concerning individual feeding trips, while in 1985 a more general overview of the distribution and feeding locations was emphasized.

Methods

Female northern fur seals from rookeries on St. Paul Island were captured with noose poles and placed on a restraint board where they were flipper tagged and had radio transmitters attached to their heads. In 1984, 40 transmitters were attached (Loughlin and Bengtson 1986); 50 were attached in 1985. The transmitters were frequency modulating (FM) blocking oscillators made by Cedar Creek; they were attached with Devcon-40 quick-drying epoxy resin. The animals were released into the rookery once the resin had hardened--a matter of only 10-15 minutes.

The females were monitored for their presence on or absence from the rookery using Esterline-Angus event recorders wired to frequency-scanning radioreceivers.

In 1985, we assessed the relative location of as many animals as possible while at sea and located them from the air rather than from a ship as was done in 1984. A Piper Navajo twin-engine airplane, mounted with a two-element Yagi antennae on each side, was used. Flights originated from St. Paul Island, were flown at 100-120 knots and at an altitude of about 1,200 m, and totaled about 60 hours of flight time.

Results

In 1985, the distribution of animals was similar to that of 1984 and previous year in that the seals were principally located to the northwest and southwest of the Pribilofs (Fig. 15)--none were located northeast or southeast of the islands, even though there was effort to locate them there:

| | <u>1984</u> | <u>1985</u> |
|--------------------------|-------------------------|---|
| Number of fur seals | 40 | 50 |
| Number located | 11 | 17 |
| % located | 28 | 34 |
| % located NW | 64 | 63 |
| % located SW | 36 | 37 |
| Max. dist. from St. Paul | 100 nmi (185 km) | ca. 205 nmi (380 km) |
| Survey coverage | 1,728 nmi (3,200 km) | 65,000 nmi ² (120,000 km ²) |

It was learned that animals encountered at feeding locations may be from any of a number of different rookeries on St. Paul Island. During 1984, fur seals were tagged at Zapadni rookery only, which is on the south side of the island, yet individual animals were followed that were tagged again at Zapadni Reef and at Northeast Point rookeries. When they were located at sea, it was found that the animals from Zapadni Reef went to the south and north of the island and those from Northeast Point went principally to the north of St. Paul Island.

Discussion

This study demonstrated that there is a substantial overlap between areas of proposed gas and oil explorations and areas where fur seals feed. A geographical comparison of fur seal movements at sea and the location of fishing effort by trawl vessels in the Bering Sea in 1984 for all fisheries also shows substantial overlap. The trawl locations along the shelf edge and elsewhere are where fisheries concentrate on walleye pollock, Theragra chalcogramma Pacific cod, Gadus macrocephalus, and other ground fish important to the fur seal's diet.

POPULATION AND BEHAVIORAL STUDIES OF NORTHERN FUR SEALS
SAN MIGUEL ISLAND, CALIFORNIA (ADAMS COVE AND CASTLE ROCK)

by

George A. Antonelis, Jr., Robert L. DeLong and Brent S. Stewart

Adams Cove

The 1985 field season in the Channel Islands of California extended from 11 June to 28 August. Research activities included population monitoring through daily censuses, a pug tagging program, and a female nursing and at-sea feeding cycle study.

Population Information

On 11 June there were 16 large adult males, 6 subadult males (bachelors), 16 adult females, and 7 live pups on the rookery. A total of 458 pups were born at the Adams Cove colony in 1985. Maximal counts of 28 large males, 13 small adults, and 54 bachelors were recorded on 3 July, 19 June, and 23 June, respectively. The greatest number of adult females on land occurred on 1 July when 315 were counted. Population information for the Adams Cove colony is summarized in Table 29 for 1980-85.

Since pup production at Adams Cove has not yet reached the number recorded in 1982 (1,029), it appears that the 1983 El Nino event, which resulted in a 60% decline in pup production and a 48.0% decrease in counts of adult females, is having a long-term effect on the population. This decline may have also resulted from either a relocation of females to other areas (e.g., Pribilof Islands) or from an increased mortality among adult female population.

Table 29.--Summary of some observations of the northern fur seal colony in Adams Cove, San Miguel Island, California, 1980-85.

| Observations | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
| Season span ^a | | | | | | |
| Beginning date | 17 May | 9 June | 9 June | 10 June | 13 June | 11 June |
| Ending date | 23 Sept. | 13 Sept. | 6 Dec. | 20 Aug. | 4 Aug. | 28 Aug. |
| First male | 17 May ^b | 9 June ^c | 9 June ^d | 10 June ^e | 13 June ^f | 11 June ^g |
| First female | 23 May | 9 June ^c | 9 June ^d | 10 June ^e | 13 June ^f | 11 June ^g |
| First birth | 24 May | 9 June ^c | 9 June ^d | 10 June ^e | 13 June ^f | 11 June ^g |
| Mean birth date | 29 June | 26 June | 25 June ^h | 2 July | 25 June ^h | 1 July |
| Median birth date | 30 June | 28 June | 28 June | 1 July | 26 June | 30 June |
| Total births | 896 | 941 | 1,029 | 408 | 478 | 458 |
| Total pup deaths | 103 | 289 | 51 | 89 | 44 | 17 |
| Total females (maximum counted & date) ¹ | 665 31 Aug. | 717 1 July | 628 8 July | 377 15 July | 333 6 July | 315 1 July |
| Total large adult males | 9 | 10 | 30 | 31 | 26 ^j | 28 ^j |
| Total small adult males | 10 | 11 | 22 ^k | 30 ^k | 18 ^k | 13 ^k |
| Total bachelors ¹ | 68 | 95 | 88 | 37 | 49 | 54 |

^a Beginning and ending dates of continuous operations.

^b Two adult males present 17 May--arrived prior to 17 May.

^c Seven adult males, 86 females, and 24 pups present 9 June--arrived prior to 9 June.

^d Seven adult males, 28 subadult males, 20 females, and 5 pups present.

^e Five large adult males, 1 small adult male, 11 subadult males, 4 females, and 1 pup present 10 June--arrived prior to 10 June.

^f Eleven large adult males, 8 small adult males, 15 subadult males, 101 females and 55 pups present 13 June--arrived prior to 13 June.

^g Sixteen large adult males, 6 bachelors, 16 females and 7 pups present 11 June--arrived prior to 11 June.

^h Estimated from previous breeding season information.

ⁱ A few 2-, 3-, and 4-year-old males may have been included because they are about the same size as adult females.

^j Maximum single count.

^k None of these males were territorial.

¹ Subadult males about 104-127 cm in body length, tip of nose to tip of tail.

To estimate the relative age structure of females in the population, the number of females with white facial vibrissae, mixed vibrissae, and black vibrissae were determined, since vibrissae color can be used as an indicator of age. For females, facial vibrissae are black at birth and remain black through age 3 years, became mixed (black and white) at ages 4 and 5 years, and by age 7 are usually entirely white.

Of 67 females examined at Adams Cove, 60 had white facial vibrissae and seven had mixed vibrissae. At Castle rock, we examined 45 females and found that 41 had white vibrissae and four had mixed vibrissae. In addition, another 22 mange-identified females were examined closely enough to determine that they all had white vibrissae. These data suggest that in 1985 the population at Castle Rock and Adams Cove was composed predominantly of older females (94.0% of all females observed were older than 6 years, based on vibrissae color) and that very few females younger than age 7 gave birth. These data differ from those reported for previous years (1970-73) when 10.0 to 35.0% of the females observed were younger than 7 years of age (based on vibrissae color ratios and known ages of tagged females, from DeLong 1982).

Foraging Characteristics of Northern Fur Seals and California Sea Lions

From 28 June to 15 August, scientists from the National Marine Mammal Laboratory and the Southwest Fisheries Center in La Jolla, California, conducted a study designed to compare the foraging strategies of northern fur seal and California sea lions, Zalophus californianus. The two species occur sympatrically during the summer breeding season on San Miguel Island where they utilize the sandy beaches of Adams Cove for rookery space.

Radio tags were attached with a quick-drying epoxy to the pelage on the heads of 25 parturient females of both species. The frequency of each transmitter was unique, allowing the activity patterns of individuals to be monitored regularly. All 50 frequencies were monitored at least four times daily to determine when each animal departed the rookery for the open sea to feed and when each returned. The distribution of tagged animals at sea was determined by flying a series of transects to the northwest, west, and southwest of the island in an aircraft equipped with radio-tracking receivers and antennas.

Preliminary results from the study indicate that the two species differ markedly in foraging strategy. Feeding bouts for fur seals averaged from 3.8 to 8.4 days per trip. These animals were frequently found over the continental slope in water which averaged 520 fathoms ($n = 18$, $SD = 332.6$, range 20-1500). The average feeding bouts for sea lions averaged 1.7 to 2.8 days per trip. Individuals were often located over the continental shelf in water which averaged 205 fathoms ($n = 15$, $SD = 215.7$, range 40-850).

Tagging Program and Records

The 1985 field season resightings of fur seals that were tagged as pups in Adams Cove from 1980 to 1982 are shown in Appendix Table A-9. Tag resightings are also reported when dead or emaciated pups of the year are found on beaches or at sea. Most of the tag recoveries have been recorded north of Point Conception, California, and along the coasts of Oregon, Washington, and British Columbia. In 1985, the southernmost

resighting of a tagged northern fur seal pup of the year (pink Roto-tag A531) was reported on the western coast of Baja California, 6 miles south of Ensenada, Mexico ($31^{\circ}45'$ N lat., $116^{\circ}34'$ W long.).

In 1985, there were no sightings of fur seals in Adams Cove from other islands. The date of first resighting for 9 females tagged as adults in Adams Cove are presented in Appendix Table A-10.

On 24 September, 100 fur seal pups were double-tagged with pink Roto-tags (hard plastic). In 1985, Roto-tags were used exclusively on pups because their numbers can be read at greater distances than those on monel tags. All tagged pups were checkmarked by removing the cartilaginous extension of the third digit on the left hind flipper (Appendix Table A-11). Twenty-one adult females were double-tagged with Yellow Riese-tags from 29 June through 7 July as part of the foraging study mentioned above (Appendix Table A-12).

Mortality on Land

The mortality of fur seal pups born in Adams Cove decreased from 9.0% (44) in 1984 to 3.7% (17) in 1985. Thirteen (76.0%) of these pups apparently died from heat prostration during a period of warm environmental conditions which occurred from 30 June to 8 July. High air and sand temperature, solar radiation, and low wind speed combine to raise a fur seal's body temperature and cause heat prostration. Two pups were stillborn and one pup apparently died of emaciation syndrome. The cause of death for the one pup was undetermined.

Castle Rock

In 1985, a count of 323 pups (312 live and 11 dead) was obtained on 4 August. This represents a decrease in pup production of 88 animals (21.0%) from 1984. A summary of census information for Castle Rock is presented in Table 27 for 1980-85.

On 1 July, 36 breeding males were counted on Castle Rock from aerial photographs, representing an increase of 3 breeding males from the 1984 count.

On 26 September, 100 fur seal pups were double-tagged with pink Rota-tags (hard plastic). All tagged pups were checked by removing the cartilaginous extension of the third digit on the left hind flipper (Appendix Table A-13).

On 4 August a tagged fur seal (pink Roto-tag C28) from the 1981 cohort was resighted on Castle Rock, the rookery of its birth.

Table 30.--Summary of numbers observed and date of observation during censuses of northern fur seals, Castle Rock, California, 1980-85.

| Observations | Year | | | | | |
|---|------------------------------|--------------------------------|--------------------------------|-------------------------------|----------------------------|----------------------------|
| | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| Females | 563(+) ^a 1 Aug | 597(+) ^a 27 July | 680(+) ^a 31 July | 245(+) ^a 3 Aug. | 411 ^a 8 Aug. | 323 ^a 4 Aug. |
| Pups (total observed) ^b | 563 ^c 1 Aug. | 597 ^c 27 July | 680 ^c 31 July | 227 ^c 3 Aug. | 411 ^c 8 Aug. | 323 ^c 4 Aug. |
| Pups (dead observed) | 38 ^c 1 Aug. | 29 ^c 27 July | 34 ^c 31 July | 18 ^c 3 Aug. | 32 ^c 8 Aug. | 11 ^c 4 Aug. |
| Reproductive large adult males ^d | 27 ^e 1 July | 28 ^e 2 July | 27 ^e 2 July | 20 ^e 1 July | 33 ^e 1 July | 36 ^e 1 July |
| Total large adult males | 32 ^e 1 July | 29 ^e 2 July | 38 ^e 2 July | 40 ^e 1 July | 43 ^e 1 July | 43 ^e 1 July |
| Total small adult males | 2 ^e 1 July | 12 ^e 2 July | 7 ^e 2 July | 13 ^e 1 July | 3 ^e 1 July | 1 ^e 1 July |

^a Minimum estimate from pup count.

^b Includes dead pup count.

^c Land-based counts from afoot.

^d Territorial adult males with females.

^e Counts were obtained through aerial photographs.

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GLOSSARY

The following terms used in fur seal research and management on the Pribilof Islands, Bogoslof Island, San Miguel Island, and Castle Rock have special meanings or are not readily found in standard dictionaries:

Bachelor-Young male seal of age 2-5 years.

Check mark-A notch, slit, hole, or other mark made on a seal flipper when a tag is applied, to ensure recognition of an animal that has lost its tag.

Drive-The act of surrounding and moving-groups of seals from one location to another.

Escapement-Seals that were not commercially harvested because they were too old, too large, or not available.

Hauling ground-An area, usually near a rookery, on which nonbreeding seals congregate. See Rookery.

Haul out-The act of seals moving from the sea to a rookery or hauling ground on shore.

Kleptogyny--The act of an adult male seal (primarily classes 1, 2, or 3) seizing an adult female from another male's territory.

Known age-Refers to a seal whose age is known because the animal bears an inscribed tag or other type of mark.

Marked--Describes a seal that has been marked by removing the cartilaginous tip of a digit from a hind flipper; attaching an inscribed metal or plastic tag to one or more of its flippers, freeze marking, hair-clipping, or bleaching.

Mark recoveries-Includes the recoveries of seals marked by one of several methods. See Marked.

Rookery-An area on which breeding seals congregate. See Hauling ground

Vibrissae (facial whiskers)--To determine the relative age structure of females in a population, the color of their facial whiskers are used. Facial vibrissae are black at birth and remain black through age 3 years; become mixed (black and white) at ages 4 and 5 years; and by age 7, the vibrissae usually are entirely white.

Classifications of adult male fur seals

Class 1 (shoreline)-Full-grown males apparently attached to "territories" spaced along the water's edge at intervals of 10-15 m. Most of these animals are wet or partly wet, and some acquire harems of one to four females between 10 and 20 July. They would then be called harem males (Class 3). Class 1 males should not be confused with Class 2 animals. The latter definitely have territories, whereas the shoreline males appear to be attached to such sites but may not be in all cases.

Class 2 (territorial without females) --Full-grown males that have no females, but are actively defending territories. Most of these animals are located on the inland fringe of a rookery, same are between Class 1 (Shoreline) and Class 3 (Territorial with females) males, and a few are completely surrounded by Class 3 males and their harems.

Class 3 (territorial with females) --full-grown males actively defending territories and females. Most Class 3 males and their harems combine to form a compact mass of animals. Isolated

individuals, usually with small harems, may be observed at each end of a rookery, on sandy beaches, and in corridors leading to inland hauling grounds. Some territorial males have as few as one or two females. Should these females be absent during the counts, their pups are used as a basis for putting the adult male in to class 3 rather than Class 2.

Class 4 (back fringe)--Full-and partly-grown males on the inland fringe of a rookery. A few animals too young and too small to include in the count maybe foundhere. Though some Class 4 males may appear to be holding territories, most will flee when approached or when prodded with a pole.

Class 5 (hauling ground)--The hauling grounds contain males from May to late July and a mixture of males and females from then on. The counts include males that obviously are adults and all others that have a mane and the body coformation of an adult. Males included in this count are approximately 7 years of age and older.

Prior to 1966, Class 3 males were called harm bulls, and Classes 1, 2, 4, and 5 were collectively called idle bulls. From 1966 through 1974, the adult male seals were classified into five groups (Classes 1, 2, 3, 4, and 5). Beginning in 1975, Classes 1 and 2 were combined and designated as Class 2, Class 3 remained the same, and Classes 4 and 5 were combined and designated as Class 5.

Table 31 lists English translations of Russian names given to some of the rookeries or hauling grounds by Russian fur hunters in late 1700s.

Table 31.--English translations of Russian names for Pribilof Island rookeries and hauling grounds.

| Island and Russian name | English translation | Comments and derivation of name |
|-------------------------|---------------------|---|
| St. Paul Island | | |
| Vostochni | --- | From "Novostoshni" meaning "place of recent growth"; applied to Northeast Point which was apparently at one time an island that has since been connected to St. Paul Island by drifting sand. |
| Morjovi | Walrus | Historically, walruses hauled out here in summer. |
| Polovina | Halfway | Halfway to Northeast Point from the village. |
| Kitovi | Of "kit" or whale | When whaling fleets were active in the Bering Sea between 1849 and 1856, a large right whale killed by some ship's crew drifted ashore here. |
| Gorbatch | Humpback | Apparently refers to the "hump like" nature of the scoria slope above the rookery. |
| Tolstoi | Thick | In this case, thick headland on which the rookery is located. |
| Zapadni | West | Western part of the island. |
| Lukanin | --- | So named after a Russian pioneer sailor who was said to have taken over 5,000 sea otters from St. Paul Island in 1787. |
| Zoltoi (hauling ground) | Golden | So named to express the metallic shimmering of the sands. |
| St. George Island | | |
| Staraya Artil | --- | Old settlement or village. There was once a settlement or village adjacent to the rookery. |
| Sea Lion Rock | | |
| Sivutch | Sea lion | These animals haul out but do not breed here. |

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APPENDIX A

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Table A-1. --Daily age classification of male northern fur seals taken in the subsistence harvest on St. Paul Island, Alaska, 17 July to 6 August 1985.

| Date | Rookery* | Males harvested | Tooth sample | Percent in each age group of sample | | | | Estimated number harvested by age group | | | |
|---------|----------|--------------------|-----------------|--|------|------|-----|--|-----|----|---|
| | | | | 2 | 3 | 4 | 5 | 2 | 3 | 4 | 5 |
| July 17 | NEP (e) | 200 | 50 | 2.0 | 86.0 | 12.0 | 0.0 | 4 | 172 | 24 | 0 |
| 18 | POL | 200 | 41 | 2.5 | 82.9 | 14.6 | 0.0 | 5 | 166 | 29 | 0 |
| 19 | L.ZAP | 197 | 50 | 10.0 | 72.0 | 18.0 | 0.0 | 20 | 142 | 35 | 0 |
| 22 | ZAP | 149 | 31 | 0.0 | 87.1 | 12.9 | 0.0 | 0 | 130 | 19 | 0 |
| 22 | L.ZAP | 54 | 11 | 0.0 | 63.6 | 36.4 | 0.0 | 0 | 34 | 20 | 0 |
| 23 | REEF | 500 | 97 | 0.0 | 86.6 | 13.4 | 0.0 | 0 | 433 | 67 | 0 |
| 24 | NEP(e) | 116 | 25 | 0.0 | 64.0 | 36.0 | 0.0 | 0 | 74 | 42 | 0 |
| 24 | NEP (w) | 85 | 18 | 0.0 | 94.4 | 5.6 | 0.0 | 0 | 80 | 5 | 0 |
| 25 | L-K | 199 | 49 | 4.1 | 85.7 | 10.2 | 0.0 | 8 | 171 | 20 | 0 |
| 26 | TOL | 200 | 37 | 8.1 | 73.0 | 18.9 | 0.0 | 16 | 146 | 38 | 0 |
| 29 | ZAP | 200 | 49 | 8.2 | 79.6 | 12.2 | 0.0 | 16 | 159 | 25 | 0 |
| 30 | REEF | 199 | 49 | 20.4 | 73.5 | 6.1 | 0.0 | 41 | 146 | 12 | 0 |
| 31 | NEP (w) | 202 | 41 | 4.9 | 82.9 | 12.2 | 0.0 | 10 | 167 | 25 | 0 |
| Aug. 1 | POL | 225 | 50 | 10.0 | 82.0 | 8.0 | 0.0 | 22 | 185 | 18 | 0 |
| 2 | TOL | 215 | 36 | 13.9 | 61.1 | 25.0 | 0.0 | 30 | 131 | 54 | 0 |
| 5 | ZAP | 188 | 46 | 4.4 | 71.7 | 21.7 | 2.2 | 8 | 135 | 41 | 4 |
| 5 | L.ZAP | 50 | 13 | 38.5 | 61.5 | 0.0 | 0.0 | 19 | 31 | 0 | 0 |
| 6 | ZOL | 200 | 46 | 17.4 | 71.7 | 10.9 | 0.0 | 35 | 143 | 22 | 0 |

- * NEP (e) = East side of Northeast Point (Morjovi)
 NEP (w) = West side of Northeast Point (Vostochni)
 TOL = Tolstoi
 POL = Polovina
 ZAP = Zapadni
 REEF = Reef and Gorbatch
 L-K = Lukanin and Kitovi
 L.ZAP = Little Zapadni
 ZOL = Zoltoi Sands

Table A-2.-- Cumulative age classification of male northern fur seals taken in the subsistence harvest on St. Paul Island, Alaska, 17 July to 6 August 1985.

| Date | Rookery * | Estimated number harvested by age group | | | | Total harvest to date | Percent harvested by age group | | | |
|---------|-----------|--|-------|-----|---|--------------------------|-----------------------------------|----|----|---|
| | | 2 | 3 | 4 | 5 | | 2 | 3 | 4 | 5 |
| July 17 | NEP (e) | 4 | 172 | 24 | 0 | 200 | 2 | 86 | 12 | 0 |
| 18 | POL | 9 | 338 | 53 | 0 | 400 | 2 | 85 | 13 | 0 |
| 19 | L.ZAP | 29 | 480 | 88 | 0 | 597 | 5 | 80 | 15 | 0 |
| 22 | ZAP | 29 | 610 | 107 | 0 | 746 | 4 | 82 | 14 | 0 |
| 22 | L.ZAP | 29 | 644 | 127 | 0 | 800 | 4 | 80 | 16 | 0 |
| 23 | REEF | 29 | 1,077 | 194 | 0 | 1,300 | 2 | 83 | 15 | 0 |
| 24 | NEP (e) | 29 | 1,151 | 236 | 0 | 1,416 | 2 | 81 | 17 | 0 |
| 24 | NEP (w) | 29 | 1,231 | 241 | 0 | 1,501 | 2 | 82 | 16 | 0 |
| 25 | L-K | 37 | 1,402 | 261 | 0 | 1,700 | 2 | 83 | 15 | 0 |
| 26 | TOL | 53 | 1,548 | 299 | 0 | 1,900 | 3 | 81 | 16 | 0 |
| 29 | ZAP | 69 | 1,707 | 324 | 0 | 2,100 | 3 | 81 | 16 | 0 |
| 30 | REEF | 110 | 1,853 | 336 | 0 | 2,299 | 5 | 80 | 15 | 0 |
| 31 | NEP (w) | 120 | 2,020 | 361 | 0 | 2,501 | 5 | 81 | 14 | 0 |
| Aug. 1 | POL | 142 | 2,205 | 379 | 0 | 2,726 | 5 | 81 | 14 | 0 |
| 2 | TOL | 172 | 2,336 | 433 | 0 | 2,941 | 6 | 79 | 15 | 0 |
| 5 | ZAP | 180 | 2,471 | 474 | 4 | 3,129 | 6 | 79 | 15 | 0 |
| 5 | L.ZAP | 199 | 2,502 | 474 | 4 | 3,179 | 6 | 79 | 15 | 0 |
| 6 | ZOL | 234 | 2,645 | 496 | 4 | 3,379 | 7 | 78 | 15 | 0 |

- * NEP (e) = East side of Northeast Point (Morjovi)
 NEP (w) = West side of Northeast Point (Vostochni)
 TOL = Tolstoi
 POL = Polovina
 ZAP = Zapadni
 REEF = Reef and Gorbatch
 L-K = Lukanin and Kitovi
 L.ZAP = Little Zapadni
 ZOL = Zoltoi Sands

Table A-3.--Number of adult male northern fur seals counted, by class^a and rookery section, St. Paul Island, Alaska, 10-21 July 1985. A dash indicates no numbered sections.

| Rookery and class of male | Section | | | | | | | | | | | | | | Total |
|------------------------------|---------|-----|----|-----|-----|-----|-----|-----|----|----|----|----|-----|----|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| <u>Lukanin</u> | | | | | | | | | | | | | | | |
| 2 | 10 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | 20 |
| 3 | 57 | 49 | - | - | - | - | - | - | - | - | - | - | - | - | 106 |
| 5 | 49 | 9 | - | - | - | - | - | - | - | - | - | - | - | - | 58 |
| <u>Kitovi^b</u> | | | | | | | | | | | | | | | |
| 2 | 9(7) | 2 | 13 | 11 | 8 | - | - | - | - | - | - | - | - | - | 50 |
| 3 | 47(18) | 18 | 57 | 62 | 59 | - | - | - | - | - | - | - | - | - | 261 |
| 5 | 0(0) | 3 | 0 | 2 | 63 | - | - | - | - | - | - | - | - | - | 68 |
| <u>Reef</u> | | | | | | | | | | | | | | | |
| 2 | 5 | 14 | 13 | 5 | 5 | 4 | 7 | 4 | 2 | 5 | 3 | - | - | - | 67 |
| 3 | 46 | 73 | 63 | 42 | 45 | 46 | 28 | 52 | 42 | 29 | 8 | - | - | - | 474 |
| 5 | 5 | 1 | 0 | 0 | 127 | 0 | 186 | 66 | 4 | 13 | 9 | - | - | - | 411 |
| <u>Gorbatch</u> | | | | | | | | | | | | | | | |
| 2 | 11 | 15 | 4 | 4 | 2 | 9 | - | - | - | - | - | - | - | - | 45 |
| 3 | 97 | 59 | 51 | 18 | 34 | 61 | - | - | - | - | - | - | - | - | 320 |
| 5 | 57 | 2 | 0 | 106 | 0 | 3 | - | - | - | - | - | - | - | - | 168 |
| <u>Arguene</u> | | | | | | | | | | | | | | | |
| 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 42 |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0 |
| <u>Morjovic^c</u> | | | | | | | | | | | | | | | |
| 2 | 10(6) | 16 | 6 | 16 | 8 | 15 | - | - | - | - | - | - | - | - | 77 |
| 3 | 40(25) | 46 | 40 | 67 | 56 | 51 | - | - | - | - | - | - | - | - | 325 |
| 5 | 84(4) | 0 | 16 | 3 | 13 | 0 | - | - | - | - | - | - | - | - | 120 |
| <u>Vostochni^d</u> | | | | | | | | | | | | | | | |
| 2 | 10 | 7 | 13 | 11 | - | 53 | 16 | 19 | 20 | 5 | 11 | 14 | 26 | 6 | 211 |
| 3 | 43 | 20 | 40 | 34 | - | 97 | 54 | 67 | 49 | 22 | 40 | 60 | 111 | 67 | 704 |
| 5 | 61 | 0 | 0 | 24 | - | 96 | 0 | 0 | 30 | 0 | 0 | 48 | 43 | 22 | 324 |
| <u>Little Polovina</u> | | | | | | | | | | | | | | | |
| 2 | 5 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | 9 |
| 3 | 22 | 14 | - | - | - | - | - | - | - | - | - | - | - | - | 36 |
| 5 | 52 | 9 | - | - | - | - | - | - | - | - | - | - | - | - | 61 |
| <u>Polovina</u> | | | | | | | | | | | | | | | |
| 2 | 12 | 8 | - | - | - | - | - | - | - | - | - | - | - | - | 20 |
| 3 | 49 | 22 | - | - | - | - | - | - | - | - | - | - | - | - | 71 |
| 5 | 200 | 24 | - | - | - | - | - | - | - | - | - | - | - | - | 224 |
| <u>Polovina Cliffs</u> | | | | | | | | | | | | | | | |
| 2 | 12 | 6 | 7 | 14 | 19 | 33 | 24 | - | - | - | - | - | - | - | 115 |
| 3 | 30 | 29 | 34 | 56 | 53 | 64 | 110 | - | - | - | - | - | - | - | 376 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | - | - | - | - | - | - | - | 7 |
| <u>Tolstoi</u> | | | | | | | | | | | | | | | |
| 2 | 16 | 5 | 14 | 1 | 13 | 12 | 21 | 41 | - | - | - | - | - | - | 123 |
| 3 | 61 | 49 | 92 | 47 | 84 | 98 | 88 | 86 | - | - | - | - | - | - | 605 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 237 | - | - | - | - | - | - | 237 |
| <u>Zapadni Reef</u> | | | | | | | | | | | | | | | |
| 2 | 6 | 23 | - | - | - | - | - | - | - | - | - | - | - | - | 29 |
| 3 | 36 | 103 | - | - | - | - | - | - | - | - | - | - | - | - | 139 |
| 5 | 38 | 24 | - | - | - | - | - | - | - | - | - | - | - | - | 62 |
| <u>Little Zapadni</u> | | | | | | | | | | | | | | | |
| 2 | 5 | 11 | 20 | 24 | 9 | 28 | - | - | - | - | - | - | - | - | 97 |
| 3 | 15 | 33 | 72 | 99 | 47 | 100 | - | - | - | - | - | - | - | - | 366 |
| 5 | 3 | 0 | 0 | 10 | 0 | 86 | - | - | - | - | - | - | - | - | 99 |
| <u>Zapadni^e</u> | | | | | | | | | | | | | | | |
| 2 | 17(0) | 27 | 26 | 23 | 35 | 41 | 29 | 7 | - | - | - | - | - | - | 205 |
| 3 | 59(0) | 89 | 67 | 105 | 71 | 70 | 76 | 10 | - | - | - | - | - | - | 547 |
| 5 | 0(87) | 22 | 12 | 9 | 164 | 0 | 11 | 149 | - | - | - | - | - | - | 454 |

^a See glossary for a description of the classes of adult male seals.

^b Numbers in parentheses are the adult males counted in Kitovi Amphitheater.

^c Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.

^d Section 6 includes adult males counted in section 5.

^e Numbers in parentheses are the adult males counted on Zapadni Point Reef.

Table A-4.--Number of adult male northern fur seals counted, by rookery, Pribilof Islands, Alaska, July 1985.

| Island and rookery | Date (July) | Class of adult male* | | | Total |
|--------------------------|----------------|----------------------|-------|-------|-------|
| | | 2 | 3 | 5 | |
| <u>St. Paul Island</u> | | | | | |
| Lukanin | 13 | 20 | 106 | 58 | 184 |
| Kitovi | 13 | 50 | 261 | 68 | 379 |
| Reef | 19 | 67 | 474 | 411 | 952 |
| Gorbatch | 19 | 45 | 320 | 168 | 533 |
| Ardiguen | 19 | 2 | 42 | 0 | 44 |
| Morjovi | 15 | 77 | 325 | 120 | 522 |
| Vostochni | 15 | 211 | 704 | 324 | 1,239 |
| Little Polovina | 10 | 9 | 36 | 61 | 106 |
| Polovina | 10 | 20 | 71 | 224 | 315 |
| Polovina Cliffs | 10 | 115 | 376 | 7 | 498 |
| Tolstoi | 19 | 123 | 605 | 237 | 965 |
| Zapadni Reef | 21 | 29 | 139 | 62 | 230 |
| Little Zapadni | 13 | 97 | 366 | 99 | 562 |
| Zapadni | 11 | 205 | 547 | 454 | 1,206 |
| Island total | | 1,070 | 4,372 | 2,293 | 7,735 |
| <u>St. George Island</u> | | | | | |
| Zapadni | 17 | 42 | 79 | 155 | 275 |
| South | 17 | 82 | 217 | 70 | 369 |
| North | 19 | 231 | 531 | 287 | 1,049 |
| East Reef | 18 | 44 | 99 | 57 | 200 |
| East Cliffs | 17, 19 | 118 | 255 | 291 | 664 |
| Staraya Artil | 17 | 114 | 105 | 111 | 330 |
| Island total | | 630 | 1,286 | 971 | 2,887 |

* See glossary for a description of the classes of adult male seals.

Table A-5.--Number of harem and idle male northern fur seals counted in mid-July, Pribilof Islands, Alaska, 1976-85. A dash indicates no data.

| Year | St. Paul Island | | St. George Island | | Total | |
|------|-----------------|-------|-------------------|-------|-------|-------|
| | Harem | Idle | Harem | Idle | Harem | Idle |
| 1976 | 5,324 | 4,041 | 1,093 | 996 | 6,417 | 5,037 |
| 1977 | 6,457 | 3,845 | 1,610 | 899 | 8,067 | 4,744 |
| 1978 | 6,496 | 3,908 | 1,590 | 1,220 | 8,086 | 5,128 |
| 1979 | 6,242 | 4,457 | 1,716 | 1,942 | 7,958 | 6,399 |
| 1980 | 5,490 | 4,248 | 1,563 | 1,795 | 7,053 | 6,043 |
| 1981 | 5,120 | 4,003 | 1,472 | 1,646 | 6,592 | 5,649 |
| 1982 | 5,767 | 4,009 | 1,410 | 1,319 | 7,177 | 5,328 |
| 1983 | 4,827 | 4,242 | - | - | 4,827 | 4,242 |
| 1984 | 4,803 | 3,977 | 1,473 | 1,452 | 6,276 | 5,429 |
| 1985 | 4,372 | 3,363 | 1,286 | 1,601 | 5,658 | 4,964 |

Table A-6.--Number of dead northern fur seal pups counted, by rookery section, Priblof islands, Alaska, 1985.
A dash indicates no data.

| Island and rookery | Date | Section | | | | | | | | | | | | | | Total |
|----------------------|------|-----------------|-----|-----|-----|------------------|-----|-----|-----|---|----|----|----|-----|----|-------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| St. Paul Island | | | | | | | | | | | | | | | | |
| Morjovi | 9/5 | 74 ^a | 38 | 71 | 17 | 26 | 21 | - | - | - | - | - | - | - | - | 247 |
| Vostochni | 8/23 | 16 | 40 | 32 | 17 | 121 | 56 | 37 | 17 | 5 | 20 | 7 | 23 | 149 | 64 | 604 |
| Little Polovina | 8/28 | 22 | 7 | - | - | - | - | - | - | - | - | - | - | - | - | 29 |
| Polovina Cliffs | 8/28 | 12 | 26 | 40 | 48 | 95 | 99 | 47 | - | - | - | - | - | - | - | 367 |
| Polovina | 8/22 | 27 | 29 | - | - | - | - | - | - | - | - | - | - | - | - | 56 |
| Arduyen ^b | 8/22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 6 |
| Gorbatch | 8/22 | 90 | 96 | 87 | 20 | 35 | 43 | - | - | - | - | - | - | - | - | 371 |
| Reef | 8/22 | 32 | 94 | 108 | 79 | 76 | 48 | 143 | 29 | 7 | 5 | 3 | - | - | - | 624 |
| Kitovi | 8/28 | 43 ^c | 10 | 55 | 65 | 38 | - | - | - | - | - | - | - | - | - | 211 |
| Lukani | 8/22 | 85 | 64 | - | - | - | - | - | - | - | - | - | - | - | - | 149 |
| Tolstoi | 9/4 | 83 ^d | - | 123 | 71 | 170 ^e | - | 204 | 268 | - | - | - | - | - | - | 919 |
| Little Zapadni | 9/4 | 12 | 56 | 125 | 162 | 96 | 34 | - | - | - | - | - | - | - | - | 485 |
| Zapadni Reef | 9/4 | 38 | 159 | - | - | - | - | - | - | - | - | - | - | - | - | 197 |
| Zapadni | 9/3 | 65 | 145 | 147 | 245 | 119 | 138 | 127 | 15 | - | - | - | - | - | - | 1,001 |
| Total | | | | | | | | | | | | | | | | 5,266 |

Table A-6.--Continued.

| Island and rookery | Date | Section | | | | | | | | | | | | | | Total |
|--------------------------|------|---------|----|-----------------|----|----|----|---|---|---|----|----|----|----|-------------|-------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| <u>St. George Island</u> | | | | | | | | | | | | | | | | |
| North | 8/16 | 41 | 68 | 34 | 87 | 23 | 64 | - | - | - | - | - | - | - | - | 317 |
| Zapadni ^f | 8/16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 134 |
| South | 8/16 | 5 | 24 | 99 ^g | - | - | - | - | - | - | - | - | - | - | - | 128 |
| East Reef ^h | 8/16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 22 |
| East Cliffs | 8/16 | 60 | 46 | - | - | - | - | - | - | - | - | - | - | - | - | 106 |
| Staraya Artil | 8/16 | 57 | 42 | - | - | - | - | - | - | - | - | - | - | - | - | 99 |
| | | | | | | | | | | | | | | | Total | 806 |
| | | | | | | | | | | | | | | | Grand total | 6,072 |

^a Includes 3 dead pups counted on second point south of Sea Lion Neck.

^b No numbered sections.

^c Includes 9 dead pups counted in Kitovi Amphitheater.

^d Includes dead pups counted in section 2.

^e Includes dead pups counted in section 6.

^f Dead pups were not counted by rookery section.

^g Includes dead pups counted in section 4.

Table A-7.--Number of dead northern fur seal pups counted, by rookery, Pribilof Islands. 1976-85^a.
A dash indicates no data.

| Island and rookery | Year | | | | | | | | | |
|-------------------------------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| <u>St. Paul Island</u> | | | | | | | | | | |
| Morjovi | 1,829 | 870 | 606 | 269 | 508 | 346 | 348 | 274 | 336 | 247 |
| Vostochni | 3,826 | 2,021 | 1,041 | 573 | 932 | 889 | 837 | 747 | 973 | 604 |
| Little Polovina | 316 | 103 | 90 | 28 | 77 | 41 | 49 | 46 | 14 | 29 |
| Polovina Cliffs | 1,862 | 733 | 761 | 433 | 627 | 463 | 570 | 438 | 397 | 367 |
| Polovina | 378 | 160 | 151 | 85 | 127 | 89 | 97 | 79 | 75 | 56 |
| Ardiguen | 212 | 112 | 15 | 31 | 76 | 38 | 49 | 33 | 46 | 6 |
| Gordatch | 1,341 | 860 | 475 | 260 | 699 | 379 | 399 | 414 | 522 | 371 |
| Reef | 2,055 | 1,233 | 593 | 651 | 790 | 623 | 654 | 649 | 411 | 624 |
| Kitovi | 846 | 331 | 203 | 171 | 256 | 187 | 269 | 223 | 142 | 211 |
| Lukanin | 385 | 250 | 197 | 132 | 206 | 102 | 139 | 171 | 104 | 149 |
| Tolstoi | 4,241 | 3,291 | 1,488 | 1,645 | 1,488 | 1,547 | 1,332 | 1,178 | 1,407 | 919 |
| Little Zapadni | 1,977 | 1,133 | 674 | 637 | 645 | 377 | 779 | 562 | 580 | 485 |
| Zapadni Reef | 638 | 427 | 129 | 161 | 243 | 266 | 276 | 258 | 301 | 197 |
| Zapadni | 3,770 | 2,559 | 1,650 | 1,368 | 1,185 | 1,451 | 1,503 | 925 | 807 | 1,001 |
| Counted total | 23,676 | 14,083 | 8,073 | 6,444 | 7,859 | 6,798 | 7,301 | 5,997 | 6,115 | 5,266 |
| Estimated oversight 5% ^b | 1,184 | 704 | 404 | 322 | 393 | 340 | 365 | 300 | 306 | 263 |
| Total | 24,860 | 14,787 | 8,477 | 6,766 | 8,252 | 7,138 | 7,666 | 6,297 | 6,421 | 5,529 |
| <u>St. George Island</u> | | | | | | | | | | |
| North | 791 | 408 | 1,068 | 774 | 949 | 810 | 649 | 367 | - | 317 |
| Zapadni | 373 | 92 | 179 | 277 | 350 | 186 | 190 | 124 | - | 134 |
| South | 280 | 98 | 225 | 186 | 197 | 177 | 110 | 111 | - | 128 |
| East Reef | 37 | 60 | 164 | 104 | 121 | 74 | 56 | 25 | - | 22 |
| East Cliffs | 354 | 140 | 292 | 285 | 284 | 402 | 340 | 128 | - | 106 |
| Staraya Artil | 454 | 410 | 590 | 565 | 484 | 376 | 315 | 148 | - | 99 |
| Counted total | 2,289 | 1,208 | 2,518 | 2,191 | 2,385 | 2,025 | 1,660 | 903 | - | 806 |
| Estimated oversight 5% ^b | 114 | 60 | 126 | 110 | 119 | 101 | 83 | 45 | - | 40 |
| Total | 2,403 | 1,268 | 2,644 | 2,301 | 2,504 | 2,126 | 1,743 | 948 | - | 846 |

Table A-7. --Continued.

| Island and rookery | Year | | | | | | | | | |
|--|--------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| <i>Pribilof Islands</i> counted total | 25,965 | 15,291 | 10,591 | 8,635 | 10,244 | 8,823 | 8,961 | 6,900 | 6,115 | 6,072 |
| Estimated oversight 5% ^b | <u>1,298</u> | <u>764</u> | <u>530</u> | <u>432</u> | <u>512</u> | <u>441</u> | <u>448</u> | <u>345</u> | <u>306</u> | <u>303</u> |
| Total | 27,263 | 16,055 | 11,121 | 9,067 | 10,756 | 9,264 | 9,409 | 7,245 | 6,421 | 6,375 |

^a Dead pups are counted after 15 August each year; most mortality has occurred by that date.

^b As established by a survey conducted in 1960: C. E. Abegglen, A. Y. Roppel, and F. Wilke. 1960. Alaska fur seal investigations, Pribilof Islands, Alaska. Unpubl. manuscript, 165 p. Natl. Mar. Mammal Lab., Northwest and Alaska Fish. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115.

Table A-8.---Sightings of northern fur seals with Soviet tags, St. Paul and Bogoslof Islands, Alaska, 1985. A dash indicates no data.

| Date of sighting | Tag number | Sex | Island | Island of tagging* | Rookery of sighting | Age | Comments |
|------------------|------------|-----|----------|--------------------|---------------------|-----|------------------------------|
| July | HB 3295 | F | St. Paul | B | Kitovi | 13 | |
| July | HB 7716 | F | St. Paul | B | Polovina | 13 | |
| July | HB 7725 | - | St. Paul | B | Northeast Point | 13 | |
| August | HM 7915 | F | St. Paul | M | Zapadni Reef | 13 | |
| August | OB 6896 | F | St. Paul | B | Gorbatch | 9 | |
| August | OM 7719 | F | Bogoslof | M | - | 9 | |
| August | XM 4825 | F | St. Paul | M | Polovina Cliffs | 7 | |
| July | XM 9453 | F | St. Paul | M | Zapadni Reef | 7 | |
| July | YM 586 | F | St. Paul | M | Kitovi | 6 | |
| July | YM 2269 | - | St. Paul | M | Tolstoi | 4 | |
| August | YM 2332 | - | St. Paul | M | Northeast Point | 4 | |
| October | YM 3018 | F | St. Paul | M | Reef | 4 | Entangled in fishing debris |
| July | bA 642 | F | St. Paul | B | Polovina | 3 | |
| August | bA 825 | - | St. Paul | B | Reef | 3 | |
| August | bA 1129 | - | St. Paul | B | Tolstoi | 3 | |
| July | MA 2990 | - | St. Paul | M | Northeast Point | 3 | Taken in subsistence harvest |
| August | TM 8237 | - | St. Paul | M | Polovina | 3 | |
| July | TM 9373 | - | St. Paul | M | Little Zapadni | 3 | Taken in subsistence harvest |
| August | TM 9508 | - | St. Paul | M | Zapadni | 3 | |
| July | TM 9809 | - | St. Paul | M | Lukanin | 3 | |
| August | TM 9925 | - | St. Paul | M | Little Zapadni | 3 | |
| July | MC 2049 | - | St. Paul | M | Zapadni | 2 | |

* M = Medney;
B = Bering.

Table A-9. --Northern fur seals tagged as pups in Adams Cove, San Miguel Island, California, and the dates first observed at Adams Cove in 1985.

| Tag number/color ^a | | Sex | Year tagged | Date of first resighting |
|-------------------------------|----------------|-----|-------------|--------------------------|
| Left flipper | Right flipper | | | |
| 441 Pink | NTR | M | 1980 | 25 June |
| 475 Pink | 475 Pink | Fb | " | 20 July |
| 481 Pink | NTR | M | " | 3 August |
| NSL | 488 Pink | Fb | " | 9 July |
| 485 Pink | NSR | Fb | " | 1 August |
| 651 Pink | 651 Pink | M | " | 23 June |
| SMI 2124 Monel | NSR | M | " | 19 June |
| NTR | SMI 2160 Monel | M | 1981 | 19 June |
| A1 Pink | NSR | F | " | 26 July |
| A2 Pink | A2 Pink | M | " | 19 June |
| NSL | A7 Pink | M | " | 27 June |
| A19 Pink | NSR | F | " | 25 July |
| A44 Pink | A44 Pink | F | " | 25 July |
| A52 Pink | NSR | F | " | 25 July |
| NSL | A67 Pink | M | " | 19 June |
| A82 Pink | A82 Pink | M | " | 23 June |
| Pink | A90 Pink | M | " | 11 June |
| A55 Green | NSR | F | " | 25 July |
| A158 Pink | NSR | M | 1982 | 3 August |

^a NSR or NSL = Right (R) or Left (L) flipper not visible; presence or absence of tag not confirmed.

NTR or NTL = Right (R) or Left (L) flipper was observed and no tag was present.

^b Known to be parturient.

Table A-10.--Northern fur seal females double-tagged with white Roto-tags in Adams Cove, San Miguel Island, California, on 18 November 1979, and dates first resighted, 1980-85. A dash indicates no data.

| Tag number ^a | | Vibrissae color ^c | Date resighted ^b | | | | | |
|-------------------------|-----------------|---------------------------------|-----------------------------|-----------|-----------|---------|---------|----------|
| Right flipper | Left flipper | | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| 401 | 402 | white | 23 July* | 6 July* | - | - | - | - |
| 404 | 403 | mixed | 10 Aug.* | 5 July* | 19 Nov. | - | - | - |
| 405 | 406 | white | 5 July* | 5 July | 3 Nov.* | - | - | - |
| 407 | 408 | white (tag lost, right side) | - | - | - | - | - | - |
| 410 | 409 | white | 1 July* | 18 June | 17 Sept. | - | - | 25 June |
| 411 | 412 | white | 6 July** | - | 18 Oct.* | - | - | - |
| 413 | 414 | mixed | 5 July | 15 July | 1 Sept. | - | - | 18 July* |
| 416 | 415 | white | 21 June** | 11 July | 17 June* | - | - | - |
| 417 | 419 | white | 5 July* | 23 July* | 29 Sept. | - | - | 25 June* |
| 420 | 421 | white | 4 July | 9 July | 4 Nov.* | - | - | 23 June |
| 422 | 423 | white | 18 July* | 15 July | 2 Sept. | 15 July | 14 July | - |
| 424 | 425 | white | 15 Aug. | 19 July | 3 Sept. | - | - | - |
| 426 | 427 | white | 27 June* | 6 July* | 11 July* | 19 June | 14 July | 5 July* |
| 428 | 430 | white | 21 June* | 6 July* | 29 June* | - | - | 25 June |
| 431 | 432 | white | 29 July | 12 Aug. | 10 Sept.* | - | - | - |
| 433 | 434 | white | 29 July | 13 Aug.* | 17 July | - | - | - |
| 435 | 437 | white | 2 June | 18 June | - | - | - | 25 June* |
| 438 | 439 | white | 5 July | 20 June | 2 Sept. | - | - | - |
| 440 | 441 | white | 5 July* | 15 July | 2 Oct. | - | - | 19 July* |
| 442 | 443 | mixed | 18 June* | 23 July | 22 Aug.* | - | - | - |
| 445 | 444 | mixed | 23 July** | - | 22 Aug. | - | - | - |
| 447 | 446 | white | 6 Sept. | 29 June** | 9 Sept.* | - | - | - |
| 448 | 449 | white | 16 Aug. ^d | - | - | - | - | - |
| 450 | 451 | white | 28 June* | 24 June | 23 June* | - | 13 July | 23 June |

Table A-I0. --Continued.

| Tag number ^a | | | Date resighted ^b | | | | | |
|-------------------------|--------------|------------------------------|-----------------------------|-----------------------|----------|---------|------|------|
| Right flipper | Left flipper | Vibrissae color ^c | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
| 452 | 453 | white | - | - | - | - | - | - |
| 454 | 455 | white | - | - | - | - | - | - |
| 456 | 457 | white | - | - | 25 July* | - | - | - |
| 458 | 459 | white | 21 June | 23 Sept. ^e | - | 23 July | - | - |
| 460 | 461 | white | 13 Aug.* | - | - | - | - | - |

^a Tags destroyed: 418, 429 and 436.

^b Symbol "*" indicates the female was known parturient that year and "***" indicates the pup was stillborn or died shortly after birth.

^c Mixed = combination of black and white. See glossary for a description of vibrissae color.

^d Died due to cliff collapse, right-side tag lost.

^e Resighted on Castle Rock.

Table A-11. --One hundred northern fur seal pups double-tagged with pink Roto-tags in Adams Cove, San Miguel Island, California, on 24 September 1985. All animals were checkmarked by removal of the cartilaginous extension of the third digit on the left hind flipper. A dash indicates no data.

| Tag number | Sex | Weight (kg) | Remarks |
|------------|-----|----------------|---------|
| A-501 | M | 14.5 | - |
| 502 | M | 13.0 | - |
| 503 | M | 10.5 | - |
| 504 | F | 10.7 | - |
| 505 | M | 14.7 | - |
| 506 | M | 12.2 | - |
| 507 | F | 10.7 | - |
| 508 | F | 10.5 | - |
| 509 | F | 9.2 | - |
| 510 | F | 11.2 | - |
| 511 | F | 10.7 | - |
| 512 | M | 13.0 | - |
| 513 | M | 12.4 | - |
| 514 | M | 11.5 | - |
| 515 | M | 9.2 | - |
| 516 | F | 10.2 | - |
| 517 | M | 15.7 | - |
| 518 | M | 13.5 | - |
| 519 | F | 13.2 | - |
| 520 | M | 11.2 | - |
| 521 | M | 15.7 | - |
| 522 | M | 12.2 | - |
| 523 | M | 11.5 | - |
| 524 | M | 11.5 | - |
| 525 | M | 12.0 | - |
| 526 | M | 14.5 | - |
| 527 | F | 10.7 | - |
| 528 | M | 12.7 | - |
| 529 | M | 12.7 | - |
| 530 | F | 9.0 | - |
| 531 | M | 12.0 | - |
| 532 | M | 11.2 | - |
| 533 | F | 11.0 | - |
| 534 | M | 12.0 | - |
| 535 | F | 10.5 | - |
| 536 | F | 12.0 | - |
| 537 | M | 12.0 | - |
| 538 | M | 11.2 | - |
| 539 | M | 10.5 | - |
| 540 | M | 11.0 | - |
| 541 | F | 7.7 | - |
| 542 | M | 10.7 | - |

Table A-11 .--Continued.

| Tag number | Sex | Weight (kg) | Remarks |
|------------|-----|----------------|---------------------------|
| A-543 | F | 8.5 | - |
| 544 | F | 11.5 | - |
| 545 | M | 14.2 | - |
| 546 | M | 11.7 | - |
| 547 | M | 11.7 | - |
| 548 | M | 16.5 | - |
| 549 | F | 11.5 | - |
| 550 | F | 10.5 | - |
| 551 | M | 10.5 | - |
| 552 | M | 12.5 | - |
| 553 | F | 9.0 | - |
| 554 | F | 11.0 | - |
| 555 | M | 0.0 | - |
| 556 | M | 11.0 | - |
| 557 | M | 13.5 | - |
| 558 | F | 11.5 | - |
| 559 | M | 13.5 | - |
| 560 | F | 12.0 | - |
| 561 | F | 9.0 | - |
| 562 | M | 11.0 | - |
| 563 | F | 11.2 | - |
| 564 | F | 8.7 | - |
| 565 | F | 11.0 | - |
| 566 | F | 10.7 | - |
| 567 | F | 9.7 | - |
| 568 | M | 12.0 | - |
| 569 | F | 10.5 | - |
| 570 | M | 13.5 | - |
| 571 | M | 11.7 | Vesicles on fore-flippers |
| 572 | M | 10.5 | - |
| 573 | M | 16.5 | - |
| 574 | F | 8.2 | - |
| 575 | F | 10.7 | - |
| 576 | M | 17.0 | - |
| 577 | M | 7.2 | - |
| 578 | M | 11.2 | - |
| 579 | F | 14.5 | - |
| 580 | M | 14.0 | - |
| 581 | F | 12.5 | - |
| 582 | M | 12.5 | - |
| 583 | F | 12.5 | - |
| 584 | M | 12.0 | - |
| 585 | M | 10.0 | - |

Table A-11. -- Continued.

| Tag number | Sex | Weight (kg) | Remarks |
|------------|-----|----------------|---------|
| 586 | M | 11.7 | - |
| 587 | F | 10.0 | - |
| 588 | M | 9.5 | - |
| 589 | F | 7.7 | - |
| 590 | F | 8.0 | - |
| 591 | F | 12.7 | - |
| 592 | F | 7.5 | - |
| 593 | M | 10.2 | - |
| 594 | F | 7.7 | - |
| 595 | F | 9.5 | - |
| 596 | M | 13.2 | - |
| 597 | M | 9.5 | - |
| 598 | M | 15.5 | - |
| 599 | F | 10.5 | - |
| 600 | F | 9.7 | - |

Table A-12 .--Twenty-one parturient female northern fur seals tagged on each foreflipper with yellow Riese-tags in Adams Cove, San Miguel Island, California, 29 June to 7 July 1985.

| Tag number ^a | Vibrissae color ^b |
|-------------------------|------------------------------|
| F-49 | white |
| 50 | " |
| 51 | " |
| 52 | " |
| 53 | " |
| 54 | " |
| 55 | " |
| 56 | " |
| 57 | " |
| 58 | " |
| 59 | " |
| 60 | " |
| 61 | mixed |
| 62 | white |
| 63 | " |
| 64 | " |
| 65 | " |
| 66 | " |
| 67 | " |
| 68 | " |
| 69 | " |
| 70 | " |

^a The same tag number was used for both right and left foreflippers.

^b Mixed = combination of black and white. See glossary for a description of vibrissae color.

Table A-13. -- One hundred northern fur seal pups double-tagged with pink Roto-tags at Castle Rock, San Miguel Island, California, on 26 September 1985. All animals were checkmarked by removal of the cartilaginous extension of the third digit on the left hind flipper. A dash indicates no data.

| Tag number | Sex | Weight (kg) | Remarks |
|------------|-----|-------------|---------------------------|
| C-401 | M | 14.5 | - |
| 402 | F | 10.5 | - |
| 403 | F | 9.0 | - |
| 404 | M | 10.7 | - |
| 405 | M | 11.2 | - |
| 406 | F | 19.5 | - |
| 407 | M | 10.5 | - |
| 408 | M | 9.7 | - |
| 409 | F | 10.0 | - |
| 410 | M | 13.0 | - |
| 411 | M | 15.7 | - |
| 412 | F | 14.7 | - |
| 413 | F | 11.5 | - |
| 414 | M | 8.7 | - |
| 415 | F | 9.5 | - |
| 416 | M | 9.5 | - |
| 417 | F | 8.7 | - |
| 418 | M | 10.7 | - |
| 419 | M | 12.5 | - |
| 420 | F | 9.2 | Vesicles sampled |
| 421 | M | 11.2 | - |
| 422 | M | 14.7 | - |
| 423 | M | 10.5 | - |
| 424 | M | 13.2 | - |
| 425 | F | 10.2 | - |
| 426 | F | 10.5 | - |
| 427 | F | 9.2 | Possible ruptured vesicle |
| 428 | M | 13.7 | - |
| 429 | M | 13.0 | - |
| 430 | F | 10.0 | - |
| 431 | M | 9.7 | - |
| 432 | F | 10.7 | - |
| 433 | F | 12.7 | - |
| 434 | F | 11.7 | - |
| 435 | M | 9.7 | - |
| 436 | M | 8.0 | - |
| 437 | M | 15.0 | - |
| 438 | F | 7.7 | - |
| 439 | M | 10.7 | - |
| 440 | M | 12.0 | - |
| 441 | F | 7.2 | - |
| 442 | M | 13.7 | - |

Table A-13 ---Continued.

| Tag number | Sex | Weight (kg) | Remarks |
|------------|-----|----------------|---------|
| C-443 | M | 14.2 | - |
| 444 | M | 12.5 | - |
| 445 | F | 10.0 | - |
| 446 | M | 10.5 | - |
| 447 | F | 11.5 | - |
| 448 | F | 11.7 | - |
| 449 | F | 10.2 | - |
| 450 | F | 8.7 | - |
| 451 | M | 13.2 | - |
| 452 | M | 14.0 | - |
| 453 | F | 7.7 | - |
| 454 | F | 12.5 | - |
| 455 | M | 10.0 | - |
| 456 | F | 9.2 | - |
| 457 | F | 13.7 | - |
| 458 | M | 12.0 | - |
| 459 | F | 12.5 | - |
| 460 | M | 11.5 | - |
| 461 | F | 10.2 | - |
| 462 | M | 11.2 | - |
| 463 | F | 9.5 | - |
| 464 | F | 8.5 | - |
| 465 | F | 12.2 | - |
| 466 | M | 12.0 | - |
| 467 | M | 12.2 | - |
| 468 | M | 8.7 | - |
| 469 | M | 11.0 | - |
| 470 | F | 9.5 | - |
| 471 | M | 10.0 | - |
| 472 | M | 11.5 | - |
| 473 | M | 11.7 | - |
| 474 | F | 7.7 | - |
| 475 | M | 12.7 | - |
| 476 | M | 10.2 | - |
| 477 | M | 8.2 | - |
| 478 | F | 13.0 | - |
| 479 | F | 11.5 | - |
| 480 | M | 11.2 | - |
| 481 | M | 17.0 | - |
| 482 | F | 12.0 | - |
| 483 | M | 12.2 | - |
| 484 | M | 12.0 | - |
| 485 | F | 11.7 | - |
| 486 | F | 10.0 | - |

Table A-13. -- Continued.

| Tag number | Sex | Weight (kg) | Remarks |
|------------|-----|----------------|---------|
| 487 | F | 12.0 | - |
| 488 | M | 12.2 | - |
| 489 | M | 8.2 | - |
| 490 | M | 9.7 | - |
| 491 | F | 8.2 | - |
| 492 | M | 12.0 | - |
| 493 | M | 13.5 | - |
| 494 | F | 9.5 | - |
| 495 | M | 12.5 | - |
| 496 | M | 9.0 | - |
| 497 | M | 9.0 | - |
| 498 | M | 11.7 | - |
| 499 | F | 10.5 | - |
| 500 | F | 10.5 | - |

APPENDIX B

Tabulations of northern fur seal entanglement data.

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Table B-1 ---Tags applied to pups of entangled and control northern fur seal females, Zapadni Reef Rookery, St. Paul Island, Alaska, 11 August 1985.

| Pup tag number* | Sex | Weight (kg) | Entangled/control female tag number |
|--------------------|-----|----------------|--|
| 401 | F | 9.2 | Control - 5002 |
| 403 | M | 7.5 | Entangled - 5003 |
| 404 | M | 11.0 | Control - 5004 |
| 406 | F | 10.5 | Control - 5006 |
| 407 | F | 6.0 | Entangled - 5007 |
| 408 | M | 7.0 | Entangled - 5008 |
| 409 | F | 8.0 | Entangled - 5018 |
| 410 | F | 9.0 | Control - 5010 |
| 412 | M | 9.0 | Control - 5012 |
| 414 | F | 7.0 | Entangled - 5014 |
| 415 | M | 8.0 | Control - 5015 |
| 417 | M | 13.5 | Control - 5017 |
| 419 | F | 10.0 | Control - 5019 |
| 421 | F | 8.0 | Control - 5021 |
| 422 | F | 6.0 | Entangled - 5022 |
| 423 | M | 9.0 | Control - 5023 |
| 424 | F | 9.0 | Entangled - 5024 |
| 425 | M | 11.0 | Entangled - 5025 |
| 426 | M | 9.0 | Entangled - 5026 |
| 427 | M | 6.0 | Entangled - 5027 |
| 428 | F | 7.0 | Entangled - 5028 |
| 429 | M | 7.5 | Entangled - 5029 |
| 430 | F | 9.0 | Entangled - 5030 |
| 431 | F | 9.0 | Control - 5031 |
| 432 | F | 8.0 | Control - 5032 |
| 433 | M | 10.0 | Control - 5033 |
| 434 | F | 8.5 | Control - 5034 |
| 435 | F | 7.5 | Control - 5035 |
| 436 | F | 7.5 | Control - 5036 |
| 438 | F | 11.0 | Control - 5038 |
| 440 | F | 7.0 | Control - 5040 |

* Tags are yellow jumbo Roto-tags.

Table B-2. --Tags applied to entangled northern fur seals during juvenile female and pup surveys, St. Paul Island, Alaska, 28 September to 12 October 1985.

| Tag number ^a | Date | Location | Age ^b | Sex | Debris type | Stretch mesh (cm) |
|-------------------------|----------|-------------|------------------|-----|----------------------|------------------------|
| 252 | 28 Sept. | Zap. Reef | pup | M | white trawl | 15.0 |
| 253 | 29 Sept. | Zap. Reef | pup | M | blue trawl | 13.0 |
| 254 | 30 Sept. | Little Zap. | BW | F | blue twine | no sample |
| 255 | 30 Sept. | Little Zap. | pup | M | white pack band | no sample |
| 256 | 30 Sept. | Little Zap. | SAM | M | white trawl | 21.0 |
| 257 | 30 Sept. | Little Zap. | SAM | M | white pack band | no sample |
| 258 | 3 Oct. | Zap. Reef | pup | M | blue-green band | no sample |
| 259 | 3 Oct. | Zap. Reef | SAM | M | green trawl | 22.0 |
| 260 | 3 Oct. | Zap. Reef | SAM | M | white trawl | 22.0 |
| 261 | 5 Oct. | Kitovi | pup | F | white hemp | no sample |
| 262 | 5 Oct. | Kitovi | BW | F | green trawl | no sample |
| 263 | 5 Oct. | Kitovi | SAM | M | grey trawl | 22.5 |
| 264 | 5 Oct. | Kitovi | BW | F | yellow band | no sample |
| 265 | 5 Oct. | Kitovi | BW | F | red rubber band | no sample |
| 266 | 5 Oct. | Kitovi | SAM | M | white pack band | no sample |
| 267 | 5 Oct. | Kitovi | WW | F | green trawl | 21.5 |
| 268 | 6 Oct. | Lukanin | pup | F | orange trawl | 18.0 |
| 269 | 6 Oct. | Lukanin | pup | M | white trawl | 22.5 |
| 270 | 6 Oct. | Lukanin | pup | F | blue pack band | no sample |
| 271 | 8 Oct. | Gorbatch | pup | M | white cloth | no sample |
| 272 | 8 Oct. | Lukanin | BW | F | green band | no sample |
| 273 | 9 Oct. | Gorbatch | SAM | M | green trawl | 21.5 |
| 274 | 9 Oct. | Reef | SAM | M | green trawl | no open mesh |
| 275 | 9 Oct. | Reef | pup | M | red cloth | no sample |
| 276 | 9 Oct. | Reef | pup | F | grey trawl | 19.0 |
| 277 | 9 Oct. | Reef | pup | F | red pack band | no sample |
| 278 | 9 Oct. | Reef | SAM | M | grey trawl | no sample |
| 279 | 9 Oct. | Reef | BW | F | grey trawl | no sample |
| 280 | 10 Oct. | Tolstoi | BW | F | grey trawl | 18.5 |
| 281 | 10 Oct. | Tolstoi | BW | F | green band | no sample |
| 282 | 10 Oct. | Tolstoi | WW | F | green trawl | 28.5 |
| 283 | 10 Oct. | Polovina | pup | F | green trawl | no open mesh |
| 284 | 11 Oct. | Zap. Reef | pup | M | green & blue trawl | blue-10.5 grn.-13.5 |
| 285 | 11 Oct. | Zapadni | pup | M | grey trawl | 21.0 |
| 286 | 12 Oct. | Tolstoi | pup | F | orange trawl & buoy | 18.5 |
| 287 | 12 Oct. | Zapadni | BW | F | green trawl | 15.5 |
| 288 | 12 Oct. | Zapadni | pup | F | yellow balloon | no sample |
| 289 | 12 Oct. | Zapadni | BW | F | green and grey trawl | 22.0-grey |
| 290 | 12 Oct. | Zapadni | pup | F | green trawl | 18.0 |
| 301 | 11 Oct. | Little Zap. | pup | F | grey trawl | 32.0-broken |

^a Orange Allflex tags.

^b BW = Black-whiskered female;

WW = White-whiskered female;

SAM = Subadult male.

Table B-3. --Miscellaneous tags recorded on northern fur seals, St. Paul Island, Alaska, 1985. A dash indicates no data.

| Date | Tag number | Color ^a | Sex | Location | Comments |
|----------|------------|--------------------|----------------|-----------------|---------------------|
| 30 July | 839 | green | F | Zap. Reef | with pup |
| 30 July | 841 | green | F | Zap. Reef | - |
| 2 Aug. | 856 | green | F | Zap. Reef | - |
| 9 Aug. | 0B-6896 | Monel | F | Gorbatch | - |
| 21 Sept. | 569 | green | F | Zap. Reef | with pup |
| 22 Sept. | 557 | blue | F | Tolstoi | - |
| 26 Sept. | 5075 | white | F | Vostochni | transmitter present |
| 28 Sept. | 859 | green | F | Zap. Reef | with pup |
| 28 Sept. | 837 | green | F | Zap. Reef | - |
| 28 Sept. | 591 | blue | F | Zap. Reef | - |
| 28 Sept. | 0019 | orange | M | Zap. Reef | entangled |
| 30 Sept. | 854 | green | F | Zap. Reef | with pup |
| 1 Oct. | 167 | orange | M | Zap. Reef | - |
| 1 Oct. | 593 | blue | F | Zap. Reef | with pup |
| 6 Oct. | 807 | pink | M | Pol. Cliffs | rub |
| 7 Oct. | 0053 | orange | M | Ardiguen | control |
| 9 Oct. | YM-3018 | Monel | F | Reef | - |
| 10 Oct. | 188 | orange | M | Tolstoi Beach | control |
| 12 Oct. | 198 | orange | M | Zapadni | entangled |
| 13 Oct. | 0019 | orange | M | Zap. Reef | entangled |
| 13 Oct. | - | pink | M ^b | Vostochni Beach | entangled |
| 23 July | XM-9453 | Monel | F | Zap. Reef | with pup |
| 23 July | 588 | blue Roto | F | Zap. Reef | - |
| 3 Aug. | 855 | blue Roto | F | Zap. Reef | - |
| 12 Aug. | 861 | blue Roto | F | Zap. Reef | - |
| 12 Aug. | 592 | blue Roto | F | Zap. Reef | - |
| 20 Aug. | 513 | blue Roto | F | Zap. Reef | - |
| 21 Aug. | HM-7915 | Monel | F | Zap. Reef | - |
| 22 Aug. | XM-4825 | Monel | F | Pol. Cliffs | with pup |
| 24 Aug. | 838 | blue Roto | F | Zap. Reef | with pup |
| 25 Aug. | 830 | blue Roto | F | Zap. Reef | - |
| 25 Aug. | 838 | blue Roto | F | Zap. Reef | - |
| 9 Sept. | 831 | blue Roto | F | Zap. Reef | - |
| 15 Sept. | 507 | blue Roto | F | Zap. Reef | - |
| 18 Aug. | 1811 | white Roto | F | Tolstoi | with pup |

^a Monel tags applied by U.S.S.R. See Appendix Table A-8 for additional data.

^b Adult male; all other males are subadults.

Table B-4.--Tag numbers of northern fur seal pups from which serum samples and rectal swabs for calcivirus isolation were collected, St. Paul Island, Alaska, 1985.

| Rookery | Tag number* | Sex | Date (November) |
|-----------------|----------------|-----|--------------------|
| Northeast Point | | | |
| | 296 | F | 10 |
| | 297 | M | 10 |
| | 298 | F | 10 |
| | 299 | M | 10 |
| | 300 | F | 10 |
| | 302 | F | 10 |
| | 303 | F | 10 |
| | 304 | M | 10 |
| | 305 | M | 10 |
| | 306 | F | 10 |
| | 307 | M | 10 |
| | 308 | F | 10 |
| | 309 | M | 10 |
| | 310 | F | 10 |
| | 311 | M | 10 |
| | 312 | F | 10 |
| | 313 | M | 10 |
| Little Zapadni | | | |
| | 314 | M | 11 |
| | 315 | M | 11 |
| | 316 | M | 11 |
| | 317 | M | 11 |
| | 318 | M | 11 |
| | 319 | F | 11 |
| | 320 | M | 11 |
| | 321 | M | 11 |
| | 321b | M | 11 |
| | 322 | F | 11 |
| | 323 | F | 11 |
| | 324 | F | 11 |
| | 325 | M | 11 |
| | 326 | M | 11 |
| | 327 | M | 11 |
| | 328 | M | 11 |
| | 329 | F | 11 |
| | 330 | F | 11 |
| | 331 | M | 11 |
| | 332 | F | 11 |

* Orange Allflex tags; numbers 321b and 326-332 were not given tags and refer to sample number only. Tag number 301 was destroyed.

Table B-S.--Entangled northern fur seals observed during the commercial harvest. St. Paul Island, Alaska, 1984.

| Kill no. | Date | Location ^a | Seals harvested | Seals entangled in debris and percent harvested | Seals observed in field with scars from prior entanglement | Skins observed in plant with entanglement scars | Field and plant entanglement scars and percent harvested | Total seals with entangling debris or scars and percent harvested |
|-----------------|------|-----------------------|--------------------|--|---|--|--|---|
| | | | No. | No. Percent | No. | No. | No. Percent | No. Percent |
| 1 | 7/2 | NEP | 792 | 3 0.38 | 0 | 1 | 1 0.13 | 4 0.51 |
| 2 | 7/3 | POL,L-K | 629 | 1 0.16 | 1 | 1 | 2 0.32 | 3 0.48 |
| 3 | 7/5 | ZAP,TZR | 1,013 | 11 1.09 | 4 | 1 | 5 0.49 | 16 1.58 |
| 4 | 7/6 | REEF | 899 | 3 0.33 | 1 | 0 | 1 0.11 | 4 0.44 |
| 5 | 7/9 | NEP | 741 | 5 0.67 | 5 | 0 | 5 0.67 | 10 1.35 |
| 6 | 7/10 | POL,L-K | 756 | 2 0.26 | 2 | 0 | 2 0.26 | 4 0.53 |
| 7 | 7/11 | ZAP | 958 | 4 0.42 | 3 | 1 | 4 0.42 | 8 0.84 |
| 8 | 7/12 | TZR | 210 | 1 0.48 | 1 | 0 | 1 0.48 | 2 0.95 |
| 9 | 7/13 | REEF | 1,059 | 6 0.57 | 7 | 0 | 7 0.66 | 13 1.23 |
| 10 | 7/16 | NEP | 703 | 4 0.57 | 5 | 0 | 5 0.71 | 9 1.28 |
| 11 | 7/17 | POL,L-K | 1,234 | 7 0.57 | 4 | 3 | 7 0.57 | 14 1.13 |
| 12 | 7/18 | ZAP | 1,124 | 6 0.53 | 2 | 0 | 2 0.18 | 8 0.71 |
| 13 | 7/19 | TZR | 588 | 4 0.68 | 2 | 1 | 3 0.51 | 7 1.19 |
| 14 | 7/20 | REEF | 992 | 1 0.11 | 3 | 1 | 4 0.40 | 5 0.50 |
| 15 | 7/23 | NEP | 813 | 2 0.25 | 3 | 2 | 5 0.62 | 7 0.86 |
| 16 | 7/24 | POL,L-K | 1,039 | 2 0.19 | 3 | 0 | 3 0.29 | 5 0.48 |
| 17 | 7/25 | ZAP | 805 | 6 0.75 | 0 | 0 | 0 0.00 | 6 0.75 |
| 18 | 7/26 | TZR | 434 | 0 0.00 | 1 | 0 | 1 0.23 | 1 0.23 |
| 19 | 7/27 | REEF | 1,414 | 2 0.14 | 3 | 2 | 5 0.35 | 7 0.49 |
| 20 | 7/30 | NEP | 1,341 | 1 0.07 | 5 | 1 | 6 0.45 | 7 0.52 |
| 21 | 7/31 | POL,L-K | 1,336 | 4 0.30 | 3 | 1 | 4 0.30 | 8 0.60 |
| 22 | 8/1 | ZAP | 1,562 | 5 0.32 | 7 | 2 | 9 0.58 | 14 0.90 |
| 23 | 8/2 | TZR | 456 | 2 0.44 | 1 | 0 | 1 0.22 | 3 0.66 |
| 24 | 8/3 | REEF | 1,168 | 5 0.43 | 2 | 0 | 2 0.17 | 7 0.60 |
| Totals | | | 22,066 | 87 | 68 | 17 | 85 | 172 |
| Average percent | | | | 0.39 | | | 0.39 | 0.78 |

^a See Figure 1. Abbreviations are: TZR = Tolstoi, Zapadni Reef, Little Zapadni; ZAP = Zapadni; NEP = Northeast Point; POL = Polovina, Little Polovina, and Polovina Cliffs; L-K = Lukanin and Kitovi; REEF = Reef, Gorbach, Zolotoi Sands.

Table B-6.--Entangled and entanglement-scarred northern fur seals examined during the commercial harvest, St. Paul Island, Alaska, 1984. A dash indicates no data.

| Date | Haul out area ^a | Specimen no. | Tag no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/loosed ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|-------------------|---------|-------------------------------------|-----------------------------|------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net(g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/2 | NEP-E | 4001 | - | Net-green | S | 210.0 | 23.0 | 3.2 | Y | T | 0 | Neck | - | 132 | 36.3 |
| " | " | 4002 | - | Net-green | M | 750.0 | 23.0 | 2.7 | Y | L | 0 | Neck | - | 112 | 23.1 |
| 7/2 | NEP-W | 4003 | - | Net-gray | S | 175.0 | 21.5 | 3.2 | Y | T | 0 | Neck | 4 | 128 | - |
| 7/3 | KIT | 4004 | - | Band-green | - | - | - | - | - | T | 0 | Neck | 2 | 104 | - |
| " | " | 4005 ^e | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| 7/5 | TOL | 4006 ^f | - | Rope-manila | - | - | - | - | - | L | 0 | Low neck | - | - | - |
| " | " | 4007 | - | Gillnet | S | 0.3 | 12.0 | 0.5 | N | T | 360 | Low neck | 2 | - | - |
| " | " | 4008 | - | Net-gray | S | 35.0 | 23.0 | 2.7 | Y | T | 0 | Neck | 3 | - | - |
| 7/5 | ZAP REEF | 40099 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| 7/5 | LIT ZAP | 4010 | - | Net-gray | S | 20.0 | 21.5 | 3.2 | Y | VT | 340 | Neck | 4 | - | - |
| " | " | 4011 ^e | - | No debris-scar | - | - | - | - | - | - | - | Neck | - | - | - |
| " | " | 4012 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | 3 | 109 | - |
| " | " | 4013 ^h | - | Net-green | L | 1330.0 | 15.0 | 3.2 | N | T | 360 | Neck | - | - | - |
| " | " | 4014 | - | Net-gray | S | 40.0 | 25.5 | 4.3 | Y | VT | 360 | Neck | 5 | - | - |
| " | " | 4015 | - | Net-blue | S | 50.0 | 24.0 | 3.2 | Y | T | 270 | Neck | 5 | - | - |

Table B-6.--Continued.

| Date | Haul out area ^d | Specimen no. | Tag no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/ loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|-------------------|---------|-------------------------------------|-----------------------------|-------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net (g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/5 | ZAP | 4016 ^h | - | Band-pink | - | - | - | - | - | VT | 0 | Neck | - | - | - |
| " | " | 4017 | - | Net-gray | S | 20.0 | 23.0 | 3.2 | Y | T | 360 | Low neck | 3 | - | - |
| " | " | 4018 ^e | - | No debris-scar | - | - | - | - | - | - | 360 | Neck | - | - | - |
| " | " | 4019 | - | Band-yellow | - | - | - | - | - | T | 0 | Neck | 3 | 115 | - |
| " | " | 4020 | - | Net-gray | M | 95.0 | 24.0 | 3.2 | Y | T | 60 | Neck/flipper | 4 | 117 | - |
| 7/6 | REEF | 4021 | - | Net-gray | S | 235.0 | 23.0 | 6.8 | Y | L | 0 | Neck | 3 | 115 | 30.4 |
| " | " | 4022 | - | Net-green | S | 20.0 | 24.0 | 3.2 | Y | T | 100 | Neck | 3 | 110 | 24.0 |
| " | " | 4023 | - | Band-lt.green | - | - | - | - | - | T | 360 | Neck | 6 | 130 | 38.6 |
| " | " | 4024 | - | No debris-scar | - | - | - | - | - | - | 10 | Neck | 4 | 112 | 27.7 |
| 7/9 | NEP-E | 4025 ^f | - | Band-yellow | - | - | - | - | - | - | - | Low neck | - | - | - |
| " | " | 40269 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4027 | 526 | Net-gray | S | - | 24.0 | 6.0 | Y | L | 0 | Neck | - | - | - |
| " | " | 4028 | 527 | Band-yellow | - | - | - | - | - | T | 0 | Neck | - | - | - |
| " | " | 4029 | - | Net-gray and band-white | S | 4.5 | 24.0 | 2.3 | Y | T ⁱ | 360 | Neck | 3 | 106 | 20.4 |

Table B-6. -- Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | Single mesh entang. | Tight/loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|--------------|----------|-------------------------------------|-----------------------------|------------------|----------------|-----------------|---------------------|--------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net(g) | Mesh size (cm) | Twine size (mm) | | | | | | | |
| 7/9 | NEP-E | 40309 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | - | - | - |
| " | " | 4031 | - | Net-gray | S | 8.0 | - | 1.7 | Y | T | 300 | Neck | 4 | 115 | 34.5 |
| " | " | 40329 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 40339 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | - | - | - |
| 7/9 | NEP-W | 4034 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | 3 | 113 | 24.5 |
| 7/10 | LIT POL | 4035 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 4 | 120 | - |
| 7/10 | POL | 40369 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4037 | - | Gillnet | S | 20.0 | 11.0 | 0.6 | N | T | 360 | Low neck | 5 | 129 | 38.1 |
| 7/10 | LUK | 4038 | - | Net-gray | S | 50.0 | 21.5 | 3.8 | Y | T | 0 | Neck | 3 | 113 | 24.5 |
| 7/11 | ZAP | 4039 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 4 | 128 | 39.0 |
| " | " | 4040 | 528 | Net-gray | L | - | 13.5 | 2.7 | N | VT | 0 | Neck | - | - | - |
| " | " | 4041j | - | String-yellow | - | - | - | - | - | L | 120 | Low neck | - | - | - |
| " | " | 4042 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 109 | 24.5 |
| " | " | 4043 | - | String-white | - | - | - | - | - | T | 0 | Head | 3 | - | - |

Table B-6. -- Continued.

| Date | Haul out area ^a | Specimen no. | Tag no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|-------------------|---------|-------------------------------------|-----------------------------|-------------------|----------------|-----------------|---------------------|--------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net (g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/11 | ZAP | 4044 | 529 | Net-green | S | - | - | - | - | T | 120 | Neck | - | - | - |
| " | " | 4045 | 530 | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| 7/12 | ZAP REEF | 4046 ^e | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7/12 | LIT ZAP | 4047 | 531 | Net-green & band-green | L | - | 21.5 | 3.2 | Y | Ti | 0 | Neck, head | - | - | 29.9 |
| 7/13 | REEF | 40489 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4048 ^k | 532 | Control | - | - | - | - | - | - | - | - | - | - | - |
| " | " | 4049 | 533 | Net-gray | M | - | 21.5 | 3.2 | Y | T | 0 | Neck | - | - | 30.8 |
| " | " | 40509 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4051 | 534 | Gillnet | S | - | - | - | N | T | 180 | Neck | - | - | 24.5 |
| " | " | 4052 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 113 | 25.4 |
| " | " | 4053 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | 2 | 112 | 25.4 |
| " | " | 4054 ^l | 535 | Band-yellow | - | - | - | - | - | L | 0 | Neck | - | - | 40.8 |
| " | " | 4055 | 536 | String-brown | - | - | - | - | - | VT | 270 | Low neck | - | - | - |
| " | " | 4056 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 5 | 129 | 42.6 |

Table B-6.--Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/loosed ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|-------------------|----------|-------------------------------------|-----------------------------|-------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net (g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/13 | REEF | 40579 | - | No debris-scar | - | - | - | - | - | - | - | Neck | - | - | - |
| " | " | 40581 | 537 | Net-gray | M | 280.0 | 24.0 | 7.3 | Y | T | 120 | Neck | 6 | - | 42.6 |
| " | " | 40599 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4060 ^f | - | Net-green | S | - | - | - | - | VT | 360 | Low neck | - | - | - |
| 7/16 | NEP-E | 4061 | 538 | Net green | L | - | 20.5 | 3.2 | Y | T | 0 ^m | Neck | - | - | 35.4 |
| " | " | 4062 | 539 | Net-green/gray | S | - | 23.0 | 3.2 | Y | TNB | 0 | Neck | - | - | 34.9 |
| " | " | 4063 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | 3 | 116 | 26.3 |
| " | " | 40649 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 4065 | 540 | Band-black & white | - | - | - | - | - | TNB | 0 | Neck | - | - | - |
| " | " | 4066 | 541 | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4067 | - | Plastic ring | - | - | - | - | - | T | 0 | Neck | 3 | 118 | 28.6 |
| " | " | 40689 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| 7/16 | NEP-W | 40699 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |

Table B-6. --Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/ loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|--------------|----------|-------------------------------------|-----------------------------|-------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net (g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/17 | POL | 4070 | 542 | Rope-green | - | - | - | - | - | TNB | 0 | Neck | - | - | 31.8 |
| " | " | 4071 | 543 | Band-blue | - | - | - | - | - | TNB | 0 | Neck | - | - | 23.6 |
| " | " | 4072 | 544 | Net-gray | S | - | 24.0 | 2.7 | Y | T | 90 | Neck | - | - | 33.6 |
| 7/17 | KIT | 4073 | 545 | Net-gray | S | - | 21.5 | 3.2 | Y | VT | 360 | Neck | - | - | - |
| " | " | 40749 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 4075 | 546 | Band-green | - | - | - | - | - | VT | 0 | Neck | - | - | - |
| 7/17 | LUK | 4076 | 547 | Rope-white | - | - | - | - | - | L | 0 | Low neck | - | - | - |
| " | " | 4077 | 548 | Net-gray | M | - | 21.5 | 3.2 | Y | T | 0 | Neck | - | - | - |
| " | " | 40789 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 40799 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 40809 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| 7/18 | ZAP | 4081 | 549 | Net-gray | M | - | 23.0 | 3.2 | Y | VT | 0 | Neck | - | - | 26.3 |
| " | " | 4082 | 550 | Band-blue | - | - | - | - | - | TNB | 330 | Neck | - | - | - |
| " | " | 4083 | 551 | Cord-gray | - | - | - | - | - | T | 180 | Low neck | - | - | - |

Table B-6. -- Continued.

| Date | Haul out area ^a | Specimen no. | Tag no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/ loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|--------------|---------|-------------------------------------|-----------------------------|-------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net (g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/18 | ZAP | 4084 | 552 | Net-blue | S | - | - | 4.3 | Y | T | 330 | Neck | - | - | - |
| " | " | 4085 | 553 | Net-green | L | - | 23.0 | 5.0 | Y | T | 0 | Neck | - | - | 39.0 |
| " | " | 40869 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 4087 | - | No debris-scar | - | - | - | - | - | - | 0 | Low shoulder | 4 | 122 | 34.5 |
| " | " | 4088 | 554 | Band-blue | - | - | - | - | - | TNB | 0 | Neck | - | - | - |
| 7/19 | LIT ZAP | 4089 | 555 | Net-gray | S | - | 23.0 | 3.8 | Y | TNB | 0 | Neck | - | - | - |
| " | " | 4090 | 556 | Band-blue | - | - | - | - | - | T | 360 | Neck | - | - | - |
| 7/19 | ZAP REEF | 4091 | 557 | Net-gray | S | - | 23.0 | 6.7 | Y | T | 0 | Neck | - | - | 28.1 |
| " | " | 40929 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | - | - | - |
| 7/19 | TOL | 40939 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4094 | 558 | Net-green | S | - | 23.0 | 3.8 | Y | T | 0 | Neck | - | - | 30.8 |
| 7/20 | REEF | 4095 | 559 | Net-gray | S | - | 21.5 | 3.2 | Y | T | 0 | Neck | - | - | 29.0 |
| " | " | 40969 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 40979 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 40989 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |

Table B-6. -- Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | Single mesh entang. | Tight/loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|--------------|-------------|-------------------------------------|-----------------------------|------------------|----------------|-----------------|---------------------|--------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net(g) | Mesh size (cm) | Twine size (mm) | | | | | | | |
| 7/23 | NEP-E | 4099 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 4 | 131 | 40.4 |
| " | " | 4100 | 560 | String-manila | - | - | - | - | - | VT | 0 | Neck | - | - | 26.3 |
| " | " | 4101 | 803/ 804 | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 4102 | 561 | Net-orange | M | - | 19.0 | 5.2 | Y | T | 0 | Neck | - | - | - |
| " | " | 4103 | 805/ 806 | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| 7/24 | LIT POL | 4104 | 562 | Net-gray | S | - | 21.5 | 5.0 | Y | T | 0 | Neck | - | - | 26.3 |
| 7/24 | POL | 4105 | 807/ 808 | No debris-scar | - | - | - | - | - | - | 0 | Head | - | - | - |
| " | " | 4106 | 809/ 810 | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 4107 | 563 | Net-gray | S | - | 25.5 | 4.3 | Y | T | 0 | Low neck | - | - | 22.7 |
| 7/24 | KIT | 4108 | 811/ 812 | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |

Table B-6. -- Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/ loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|-------------------|-------------|-------------------------------------|-----------------------------|-------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net (g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/25 | ZAP | 4109 | 564 | Band-blue | - | - | - | - | - | T | 0 | Neck | - | - | 27.2 |
| " | " | 4110 | 565 | Net-green | S | - | - | - | Y | VT | 0 | Neck | - | - | 36.3 |
| " | " | 4111 | 566 | Band-white | - | - | - | - | - | T | 0 | Head | - | - | - |
| " | " | 4112 | 567 | Net-gray | S | - | 28.0 | 4.3 | Y | T | 90 | Neck | - | - | - |
| " | " | 4113 | 568 | Band-blue | - | - | - | - | - | TNB | 0 | Neck | - | - | 31.8 |
| " | " | 4114 | 569 | Net-gray | S | - | 23.0 | 3.5 | Y | L | 0 | Neck | - | - | 25.4 |
| 7/26 | TOL | 4115 | 813/ 814 | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| 7/27 | ZOL | 4116 | - | No debris-scar | - | - | - | - | - | - | 5 | Shoulder | 4 | 123 | 26.3 |
| 7/27 | REEF | 4117 ⁿ | 570 | Net-gray | M | 325.0 | 24.0 | 2.8 | Y | T | 360 | Low neck | - | - | - |
| " | " | 4118 ^e | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| " | " | 4119 | 571 | Net-green | S | - | 26.5 | 2.3 | Y | VT | 270 | Neck | - | - | - |
| " | " | 4120 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 120 | 33.6 |

Table B-6. -- Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/ loose ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|--------------|-------------|-------------------------------------|-----------------------------|------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net(g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 7/30 | NEP-E | 4121 | - | No debris-scar | - | - | - | - | - | - | 0 | Head, neck | 2 | 107 | 24.5 |
| " | " | 4122 | 572 | Band-white | - | - | - | - | - | L | 0 | Neck | - | - | - |
| " | " | 4123 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 120 | 32.2 |
| 7/30 | NEP-W | 4124 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 113 | 24.0 |
| " | " | 4125 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 116 | 26.3 |
| " | " | 4126 | 815/ 816 | No debris-scar | - | - | - | - | - | - | 0 | Low neck | - | - | - |
| 7/31 | LUK | 4127 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | 2 | - | 20.9 |
| " | " | 4128 | 573 | Band-yellow | - | - | - | - | - | T | 160 | Low neck | - | - | - |
| " | " | 4129 | 817/ 818 | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4130 | 574 | Net-blue | S | - | - | 3.8 | Y | TNR | 0 | Neck | - | - | - |
| " | " | 4131 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck & shoulder | 3 | 121 | 36.3 |
| " | " | 4132 | - | Plastic | - | - | - | - | - | T | 0 | Lower jaw/ mouth | 2 | - | - |

Table B-6. --Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | | | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|--------------|-------------|-------------------------------------|-----------------------------|------------------|----------------|-----------------|---------------------|--------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net(g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | Tight/loose ^d | | | | | |
| 8/1 | ZAP | 4133 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | 2 | 107 | 23.6 |
| " | " | 4134 | - | No debris-scar | - | - | - | - | - | - | 0 | Neck | 3 | 114 | 29.0 |
| " | " | 4135 | 575 | Net-gray | S | - | - | 2.7 | Y | TNB | 0 | Neck | - | - | - |
| " | " | 4136 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 2 | 110 | - |
| " | " | 4137 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | 3 | 120 | 31.3 |
| " | " | 4138 | 576 | Net-orange | S | - | - | - | Y | TNB | 270 | Neck | - | - | - |
| " | " | 4139 | 577 | Net-gray | M | - | 21.5 | 2.7 | Y | T | 0 | Neck | - | - | - |
| " | " | 4140 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | 3 | 112 | 27.7 |
| " | " | 4141 | 578 | Band-blue | - | - | - | - | - | TNB | 0 | Neck | - | - | - |
| " | " | 4142 | 579 | Rope-yellow | - | - | - | - | - | TNB | 0 | Neck | - | - | - |
| " | " | 4143 | 819/ 820 | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |
| " | " | 4144 | 821/ 822 | No debris-scar | - | - | - | - | - | - | 0 | Neck | - | - | - |

Table B-6.--Continued.

| Date | Haul out area ^a | Specimen no. | Tag. no. | Type & color of debris ^b | Description of net fragment | | | | | Tight/loosed ^d | Degree of open wound | Area of entanglement or scar | Age | Body length (cm) | Body weight (kg) |
|------|----------------------------|--------------|-------------|-------------------------------------|-----------------------------|-------------------|----------------|-----------------|---------------------|---------------------------|----------------------|------------------------------|-----|------------------|------------------|
| | | | | | Quan. of net ^c | Weight of net (g) | Mesh size (cm) | Twine size (mm) | Single mesh entang. | | | | | | |
| 8/2 | TOL | 4145 | 580 | Net-gray | M | - | 21.5 | 5.0 | Y | T | 0 | Neck | - | - | - |
| " | " | 4146 | 581 | Net-green | S | - | - | 2.3 | Y | TNB | 0 | Neck | - | - | - |
| " | " | 4147 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 119 | 30.8 |
| 8/2 | LUK | 4148 | 582 | Cord-brown | - | - | - | - | - | T | 310 | Neck | - | - | - |
| 8/3 | REEF | 4149 | 823/ 824 | Rope-green | - | - | - | - | - | T | 0 | Neck | - | - | - |
| " | " | 4150 | - | No debris-scar | - | - | - | - | - | - | 0 | Shoulder | 3 | 122 | 32.7 |
| " | " | 4151 | 583 | Net gray | S | - | 21.5 | 2.6 | Y | TNB | 0 | Neck | - | - | - |
| " | " | 4152 | 584 | Band-blue | - | - | - | - | - | TNB | 0 | Neck | - | - | - |
| " | " | 4153 | 585 | Gillnet | S | - | - | 0.3 | N | T | -0 | Head/low neck | - | - | - |
| " | " | 4154 | 586 | Net-green | S | - | - | - | Y | TNB | 0 | Neck | - | - | 32.7 |
| " | " | 4155 | - | No debris-scar | - | - | - | - | - | - | 0 | Low neck | 3 | 113 | 28.6 |

Table B-6.--Continued.

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- a See Figure 1 and footnote (a) in Appendix Table B-1.
 - b Includes seals without debris that had a scar indicative of prior entanglement (no debris).
 - c Quantity of net: Small (S) = < 150 g; Moderate (M) = 151-500 g; Large (L) = > 501 g.
 - d Tight (T) = debris tightly bound; Very Tight (VT) = constricting; Tight Not Binding (TNB) = appears tight; Loose (L) = debris can be easily removed.
 - e Oversized seal (> 125 cm) released alive; not tagged.
 - f Oversized seal (> 125 cm) released alive with debris intact; not tagged.
 - g Entanglement-scarred seal released alive; not tagged.
 - h Oversized seal (> 125 cm) released alive after debris was removed; not tagged.
 - i Net was tight; band was loose.
 - j Debris came off of seal during restraint procedure; seal released alive; not tagged.
 - k No specimen number assigned. Seal was not entangled nor did it have entanglement scars. Seal was tagged as a "control" animal.
 - l Seal died on restraint board.
 - m Seal with minimum 90° open wound. Ventral and lateral areas of neck were not accessible for examination.
 - n Seal was entangled about its lower jaw. The tongue was cut, but no wounds were visible in epidermis on lower jaw.
 - o Seal had a series of small unconnected open wounds 360° around its neck.

Table B-7.--Entanglement-scarred northern fur seal skins observed in the skin processing plant, St. Paul Island, Alaska, 1984.

| Date | Location ^a where harvested | Specimen no. | Area of entanglement | Observations of dermis | Fur marks | Skin quality ^b |
|------|--|-----------------|-------------------------|--|-----------------------------|------------------------------|
| 7/2 | NEP | 4501 | Neck | 360° faint pink band | No obvious marks | C |
| 7/3 | POL, LUK-KIT | 4502 | Neck | 360° faint pink line | No obvious marks | C |
| 7/5 | ZAP, TZR | 4503 | Neck | 360° intermittent indentation, 1 cm wide | 3-90° lines, white hair | R |
| 7/11 | ZAP | 4504 | Neck | 360° faint blue line, 2 cm wide | No obvious marks | C |
| 7/17 | POL, LUK-KIT | 4505 | Neck | 90° indentation, 2 cm wide | Obvious 90° line in hair | C |
| " | " | 4506 | Neck | 270° indentation, 1-2 cm wide | Faint mark | C |
| " | " | 4507 | Neck | 360° thickened tissue, skin cut ventrally by machine | No obvious marks | R |
| 7/19 | TZR | 4508 | Neck | 240° indentation with stitch appearance | Obvious mark | R |
| 7/20 | REEF | 4509 | Neck | Machine cut along entanglement line, yellowish margin | Cut by machine | R |
| 7/23 | NEP | 4510 | Neck | 360° pink line | No obvious marks | C |
| " | " | 4511 | Neck | 360° pink line | No obvious marks | C |
| 7/27 | REEF | 4512 | Neck | Machine cut | Rub line over left shoulder | R |
| " | " | 4513 | Neck | 90° thickened tissue ("lump line") | No obvious marks | C |

Table B-7. -- Continued.

| Date | Location ^a where harvested | Specimen no. | Area of entanglement | Observations of dermis | Fur marks | Skin quality ^b |
|------|--|-----------------|-------------------------|--------------------------------------|------------------------------|------------------------------|
| 7/30 | NEP | 4514 | Neck | 90° new skin growth | Rub line | C |
| 7/31 | POL, LUK-KIT | 4515 | Shoulders | 90° indentations (two), 1 cm wide | No obvious marks | C |
| 8/1 | ZAP | 4516 | Neck | 90° indentation, machine cut | Rub line and black hair line | C |
| " | " | 4517 | Neck | 320° indentation | Slight 360° line | C |

^a See Figure 1.

^b Pelts with significant damage due to the entanglement are rejected from the commercial production;
C = commercial; R = reject.

Table B-8.--Resightings of entangled northern fur seals tagged and released in 1984, Pribilof Islands, Alaska.
A dash indicates no data.

| Date and location ^a of tagging | Tag. no. | Observations when tagged in 1984 | Date and location of resighting ^b 1984 | Observations when resighted |
|--|-------------|-------------------------------------|---|--|
| 7/9 NEP-E | 526 | Net-gray, loose, no wound | 7/16* NEP-W | Net on tight; not cutting into skin; large mesh; heavy twine |
| 7/9 NEP-E | 527 | Band-yellow, tight, no wound | 7/20* REEF | Yellow band on tight |
| 7/11 ZAP | 528 | Net-gray, very tight, no wound | 7/13* REEF | Gray net; no cuts; small dress; one loop around flipper |
| | | | 7/20* REEF | - |
| 7/11 ZAP | 529 | Net-green, tight, 120° wound | 7/18* ZAP | - |
| 7/13 REEF | 532 | Control | 7/20* REEF | - |
| 7/13 REEF | 534 | Gillnet, tight, 180° wound | 7/20* REEF | - |
| 7/17 POL | 543 | Band-blue, TNB, 330° wound | 8/10 Gorbatch | - |
| 7/17 POL | 544 | Net-gray, tight, 90° wound | 7/24* POL | - |
| 7/17 LUK | 547 | Rope-white, loose, no wound | 7/24* LUK | - |
| | | | 7/27* REEF | - |
| 7/17 LUK | 548 | Net-gray, tight, no wound | 7/24* LUK | - |
| 7/19 LIT ZAP | 555 | Net-gray, TNB, no wound | 8/11 St. George | Gray net; fur rubbed on neck; subadult male |
| 7/19 LIT ZAP | 556 | Band-blue, tight, 360° wound | 7/27* REEF | - |
| 7/25 ZAP | 564 | Band-blue, tight, no wound | 8/1* ZAP | Blue band on tight; doesn't appear cut; dangling piece of band-ventrally; black whiskers |

Table B-8.--Continued.

| Date and location ^a of tagging | Tag. no. | Observations when tagged in 1984 | Date and Location of resighting ^b 1984 | Observations when resighted |
|---|----------|----------------------------------|---|--|
| 7/31 LUK | 573 | Band-yellow, tight, 160° wound | 8/2* LUK | Band on tight; doesn't appear cut |
| 7/31 LUK | 574 | Net-blue, TNB, no wound | 8/2* KIT | No debris; no cuts; rub on neck |
| | | | 8/3* REEF | - |
| 7/23 NEP-E | 803/804 | Scar, no open wound, low neck | 7/30* NEP-E | 360° scar line on low neck; deeper ventrally; appears to be a recently healed 270° wound |
| 7/24 POL | 807/808 | Scar, no open wound, head | 7/31* LIT POL | - |
| 7/24 POL | 809/810 | Scar, no open wound, low neck | 7/31* LIT POL | - |
| 7/26 TOL | 813/814 | Scar, no open wound, low neck | 8/2* TOL | Scar; white whiskers |

^a See Figure 1 and footnote (a) in Appendix Table B-1.

^b Asterisk (*) indicates sighting occurred during the commercial harvest on St. Paul Island. See Footnote (a) for locations.

Table B-9.--Sightings made in 1984 of entangled northern fur seals tagged and released in 1983, Pribilof Islands, Alaska.
A dash indicates no data.

| Tag no. | Date | Location of in 1983 ^a | Observations when in 1983 | Date | Location of 1984 ^b | Observations in 1984 |
|---------|---------|----------------------------------|---|------|-------------------------------|---|
| 411 | 7/8/83 | REEF | Band-yellow on low neck; no wounds; TNB. | 7/27 | *REEF | No debris; no wounds; slight indentation on left shoulder extending to dorsal; white whiskers; double-tagged. |
| 423 | 7/11/83 | ZAP REEF | Net-green on low neck; 360° wound; tight; small amount of net; 21 cm mesh. | 7/10 | *LUK | Debris on tight; 360° wound, 2 cm wide; seal weak. |
| | | | | 7/13 | *REEF | Green net on tight; 360° wound; one mesh loop around neck; skin bulging dorsally; long white whiskers, but seal is size of a 4 year old; short trailers from two knots. |
| | | | | 7/14 | REEF | - |
| 425 | 7/12/83 | ZAP | Band-white on neck; 180° wound; loose. | 7/11 | *ZAP | Seal not seen, but tag was found during drive; seal must not have had any debris or marks or it would have been observed. |
| 428 | 7/13/83 | NEP-E | Net-green on neck; no wounds; TNB; small amount of net; 28 cm mesh. | 7/6 | *REEF | No debris; no marks. |
| 429 | 7/13/83 | NEP-E | Net-green on low neck & flipper; no wounds; TNB; 5 strands around neck; medium amount of net; 26 cm mesh. | 7/6 | *REEF | - |
| | | | | 7/20 | *REEF | No debris; no marks. |

Table B-9. --Continued.

| Tag no. | Date | Location of tagging in 1983 ^a | Observations when tagged and released in 1983 | Date | Location of sighting in 1984 ^b | Observations in 1984 |
|---------|---------|--|---|------|---|--|
| 430 | 7/13/83 | NEP-E | Net-green; 18 strands around neck; no wounds; TNB; large amount of net; 24 cm mesh. | 7/2 | *NEP-E | No debris; no marks; healthy appearance. |
| | | | | 7/9 | *NEP-E | - |
| | | | | 7/21 | St. George I. Zapadni | No sign of net or net scars; recorded as blue tag 30, but must be 430 as no other seal has such tags. |
| 436 | 7/14/83 | POL | Net-green, 5 strands around neck; no wounds; TNB; small amount of net; 23 cm mesh. | 7/29 | St. George I. East Cliffs | Green net around neck; cut badly into flesh; double-tagged, tags faded. |
| | | | | 7/31 | " | Green net on subadult male. |
| | | | | 8/1 | " | Green net on subadult male. |
| 442 | 7/15/83 | REEF | Net-gray on neck; 270° wound; very tight; one mesh total. | 7/5 | *LIT ZAP | Yellowish tips of something; barely visible; 360° wound, 1 cm wide; tag on right flipper only. |
| | | | | 7/19 | *LIT ZAP | No debris; healed wound; deep groove in skin ventrally, but not an open cut; skin bulging 300°, but not dorsal; just rub mark dorsally, not recently cut; rub line on shoulders posterior to wound; tag on right flipper only. |
| 444 | 7/18/83 | LIT ZAP | Net-gray, 5 strands around neck; no wound; loose; small amount of net; 23 cm mesh. | 7/26 | *LIT ZAP | Gray net on tight; 360° wound; skin bulging ventrally & dorsally, but more so ventrally; one mesh trailer, broken meshes; black whiskers; double-tagged. |

Table B-9. -- Continued.

| Tag no. | Date | Location of tagging in 1983 ^a | Observations when tagged and released in 1983 | Date | Location of sighting in 1984 ^b | Observations in 1984 |
|---------|---------|--|--|------|---|--|
| 464 | 7/22/83 | REEF | Rope-greenish on neck; 270° wound; very tight; tied with knot. | 7/6 | *REEF | One strand of debris with knot in front and 3 cm hanging; 360° wound. |
| | | | | 7/13 | *REEF | Yellowish band; 360° wound. |
| 466 | 7/26/83 | ZAP | Net-gray, 2 strands around neck; 360° wound; loose; small amount of debris; 23 cm mesh. | 6/24 | St. George Zapadni | Gray net around neck removed by biologists; recorded as blue tag 66, but must be 466 as no other seal has such tags. |
| 468 | 7/26/83 | ZAP | Net-brownish red, 2 strands around neck; no wound; tight; small amount of net; 21.5 cm mesh. | 8/1 | *ZAP | Yellowish or manila string on neck; 360° wound; matted hair from oil or blubber; black & white whiskers; wide wound-skin separated; blubber exposed. |
| 471 | 7/27/83 | NEP-E | Net-gray, 10 strands around neck; no wound; tight; medium amount of net; 21.5 cm mesh. | 7/6 | *REEF | Gray net; no visible wound; debris tight, but not binding; medium dress. |
| | | | | 7/13 | *REEF | Gray net; tight. |
| | | | | 7/20 | *REEF | Gray net; no cuts. |
| 472 | 7/27/83 | NEP-E | Net-gray, 8 strands around neck; no wound; tight; medium amount of net; 23 cm mesh. | 8/2 | *TOL | Gray net; 360° wound, not deep, but through skin; net on tight; small dress. |

Table B-9. -- Continued.

| Tag no. | Date | Location of tagging in 1983 ^a | Observations when tagged and released in 1983 | Date | Location of sighting in 1984 ^b | Observations in 1984 |
|---------|---------|--|--|------|---|--|
| 476 | 7/28/83 | KIT | Plastic packing material on shoulder; no wound; tight. | 7/24 | *KIT | No debris; no marks. |
| | | | | | *REEF | No debris; very slight 60° fur mark on right shoulder, two slight lines, not very obvious; black whiskers; double-tagged. |
| | | | | 7/31 | *KIT | No debris; very faint line over right shoulder, barely visible; black whiskers; double-tagged. |
| 477 | 7/29/83 | REEF | String; 70° wound on each shoulder; left cut deeper than right. | 8/2 | *KIT | No debris; no wounds. |
| | | | | 7/6 | *REEF | No debris; obvious marks on shoulders; left shoulder has an indented fur rub that looks like a recently healed wound; right shoulder has obvious fur rub; tag on right flipper only. |
| | | | | 7/17 | *KIT | Scars on both shoulders, 3 cm wide rub, 60° over each shoulder; tag on right flipper only. |
| 480 | 7/29/83 | REEF | Net-green, more than 2 strands around neck; 360° wound; very tight; small amount of net; 24 cm mesh. | 7/27 | *REEF | Green net on neck very tight; 180° wound dorsally, skin bulging; doesn't appear cut ventrally; fur rub marks around gape of mouth; small dress, couples of meshes bunched on left; appears to be one or two mesh loops around neck; black and white whiskers; double-tagged. |

Table B-9. --Continued.

| Tag no. | Date | Location of tagging in 1983 ^a | Observations when tagged and released in 1983 | Date | Location of sighting in 1984 ^b | Observations in 1984 |
|---------|---------|--|--|------|---|--|
| 482 | 7/29/83 | REEF | Net-gray, two strands around neck; no wounds; loose; small amount of net; 22 cm mesh. | 7/22 | St. George East Cliffs | No debris; net scars present on neck. |
| 487 | 8/3/83 | NEP-E | Net-green on neck; no wounds; tight, not binding; large amount of net; 16.5 cm mesh. | 7/17 | *KIT | Gray net; 360° deep wound; very deep cut dorsally, large skin bulge, one strand of debris around neck; large knot in debris ventrally. |
| 489 | 8/3/83 | NEP-W | Plastic gasket on neck; 360° wound; tight. | 7/6 | *REEF | Plastic gasket; 360° deep wound to muscle; gasket cut off of seal and collected; seal was released. |
| | | | | 7/7 | REEF | No debris; deep scar; tag on left flipper only; indented skin. |
| | | | | 7/23 | *NEP-E | No debris; wound healed; beaded tissue in groove in hair; deeper dorsally. |
| 493 | 8/5/83 | REEF | Red rubber gasket on neck; wounds; tight. | 7/25 | St. George East Cliffs | No further notes. |
| | | | | 8/1 | St. George East Cliffs | No debris; faint net scars present; double-tagged. |
| 495 | 8/5/83 | REEF | Net-gray on neck & flipper; no wounds; loose; neck in two holes in net; small amount of net. | 6/24 | St. George Zapadni | No debris. |
| | | | | 6/25 | St. George Zapadni | No debris. |

Table B-9.--Continued.

| Tag no. | Date | Location of tagging in 1983 ^a | Observations when tagged and released in 1983 | Date | Location of sighting in 1984 ^b | Observations in 1984 |
|------------|--------|--|---|------|---|--|
| 497 | 8/5/83 | REEF | Net-gray, 4 strands on neck; 360° deep wound; tight. | 6/24 | St. George Zapadni | Hemp-colored net around neck; cutting very badly. |
| 498 | 8/5/83 | REEF | Cloth band on neck; no wounds; loose. | 7/27 | *REEF | No debris; no marks; healthy appearance; black and white whiskers; 4 years old. |

^a All seals were tagged during the harvest on St. Paul Island, 1983. See Figure 1.

^b All locations are St. Paul Island (Fig. 1) unless otherwise indicated. An asterisk (*) indicates the observation was made during the commercial harvest on St. Paul Island.

Table B-10.--Observations of entangled northern fur seals (exclusive of the commercial harvest), Pribilof Islands, Alaska, 1984. A dash indicates no data.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|------|-----------------------|--|--|---|--|-----------------------------------|
| 6/12 | Tolstoi | H | 80 | 0 | - | JS |
| 6/13 | NEP-E, Catwalk | B | 2 females and undetermined number of adult males | 1 | Green net on female. | JS |
| 6/13 | Polovina | H | 50 | 0 | - | JS |
| 6/13 | Little Zapadni | H | 70 | 0 | - | JS |
| 6/14 | Tolstoi | H | 100 | 0 | - | JS |
| 6/30 | Tolstoi | B | 1200 females and undetermined number of adult males | 0 | - | JS |
| 6/30 | Tolstoi | H | 250 | 1 | Gray net on small male; medium amount. | JS |
| 6/30 | Lukanin Beach | - | - | 1 | Green net on large male; seal was on a beach area that is not a normal haul-out area; seal came ashore for few minutes then went back to sea. | JS |

Table B-10. -- Continued.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|------|--|--|---|---|---|-----------------------------------|
| 7/7 | Reef Catwalk (survey specifically for entangled females) | B | 6200 females and undetermined number of adult males | 4 | 1) Green rope on neck of female; tight; no visible cuts. 2) Thin line scar around neck of female. 3) White net on neck of female; medium amount; tight; entangled in mesh loop. 4) Scar mark around head of female; skin indented; debris may be imbedded in skin; no open wounds. | JS, NB, AF |
| 7/7 | Reef | H | 75 | 1 | No debris; deep scar; blue tag 489. | JS, NB, AF |
| 7/7 | Reef-Castle Rock | H | 50 | 0 | - | JS, NB, AF |
| 7/7 | Reef Point | - | - | 1 | Green net on adult male; large amount of net; seal was inland away from breeding area. | JS, NB, AF |
| 7/8 | NEP-E Catwalk (survey specifically entangled females) | B | 3200 females and undetermined number of adult males | 2 | 1) White band and gray net on young male; this subadult male was in breeding area near females and adult males (unusual occurrence). 2) Single strand of debris (possibly a band) on neck of female; very tight. | JS, NB, AF |
| 7/9 | NEP-W (during bull count) | B & H | 485 adult (harem) males, 153 adult (territorial) males, 206 adult (idle) males, and undetermined number of females | 1 | Deep scar/cut on territorial bull; debris not visible. | JS, PK |

Table B-10. -- Continued.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|------|--|--|--|---|---|-----------------------------------|
| 7/9 | NEP-E Catwalk | B & H | 140 adult (harem) males, 85 adult (territorial) males, 149 adult (idle) males, and 3000 females | 0 | - | JS, PK |
| 7/9 | NEP-E (during bull count) | B & H | 186 adult (harem) males, 58 adult (territorial) males, 197 adult (idle) males, and undetermined number of females | 1 | Scar on low neck of territorial bull. | JS, PK |
| 7/9 | NEP-E (during bull count) | B & H | 334 adult (harem) males, 123 adult (territorial) males, and undetermined number of females | 1 | Blue net on female; medium amount of net. 102 adult (idle) males, | JS, PK |
| 7/10 | Polovina | H | 80 | 0 | - | JS, NB, AF |
| 7/13 | Little Zapadni | H | - | 1 | Blue net on female; medium amount of net. | JS, NB, AF |
| 7/14 | Reef Catwalk (survey specifically for entangled females) | B | 4000 females and undetermined number of adult males | 1 | Green net on female; medium amount. | NB, AF, HK |

Table B-10. --Continued.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|------|---|--|---|---|--|-----------------------------------|
| 7/14 | Reef | H | - | 3 | 1) Entangled male 2) Entangled male 3) Entangled male; blue tag 423. | NB, AF, HK |
| 7/15 | NEP-E Catwalk (survey specifically for entangled females) | B | 5800 females and undetermined number of adult males | 1 | Green net on neck of female; tight; small amount. | JS, NB, AF, HK |
| 7/14 | NEP-E Area 1 | H | 100 | 1 | Green net on neck of young male. | JS, NB, AF, HK |
| 7/15 | NEP-E Area 1 | H | - | 1 | Green net on neck of young male; observed during round-up for harvest, but seal escaped and is not included in harvest tally; same seal as 7/14. | NB |
| 7/19 | Zapadni Reef | H | - | 1 | Green net on adult male; observed during round-up for harvest, but seal escaped and is not included in harvest tally. | NB |
| 7/21 | Zolotoi Sands | H | 150 | 0 | - | JS, NB, HK, AF |
| 7/24 | St. George I. East Cliffs | B | | 1 | Blue net on neck of female; medium quantity of net. | JS |
| 7/25 | Reef Catwalk | B | 1200 females and undetermined number of adult males | 1 | Orange net on neck of females; entangled in mesh loop; small amount of net. | JS |

Table B-10. --Continued.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|------|--|--|---|---|---|-----------------------------------|
| 7/29 | Reef Catwalk (survey specifically for entangled females) | B | 1200 females and undetermined number of adult males | 3 | 1) Green net on neck of female; medium amount of net; same seal as 7/14. 2) Orange net on neck of female; same seal as 7/25. 3) Scar on low neck of female; appears cut; has a pup. | JS, NB, AF |
| 8/4 | NEP-W Area 1 | H | 150 females and two adult males | 0 | - | JS, HK, SZ |
| 8/4 | NEP-W Area 2 | H | 30 adult males and 10 subadult males | 1 | Green net on subadult male. | JS, HK, SZ |
| 8/4 | NEP-E Area 1 | H | 20 | 1 | Green net on subadult male; large quantity of net. | JS, HK, SZ |
| 8/5 | Zapadni Reef | B | - | 2 | 1) Net on adult male holding females (harem bull); net on neck over shoulders. 2) Scars on female; 90° healed wound dorsally; female had been tagged. | HK |
| 8/6 | Zapadni Reef | B | - | 1 | White net on pup. | HK |
| 8/10 | Gorbatch | H | - | 2 | 1) Entangled; blue tag 543. 2) Green net; blue tag not read. | HK |

Table BI-10. --Continued.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|------|-----------------------|--|--|---|--|-----------------------------------|
| 9/18 | Reef | B | - | 1 | Band or scar on female. | HK |
| 8/18 | Reef | H | 75-100 | 2 | 1) Green net on seal; large quantity of net. 2) Green net on seal. | HK |
| 9/18 | Zapadni Reef | B | 800-1000 females | 3 | Three entangled seals observed (probably all females). | HK |
| 9/19 | Zapadni Reef | B | 200 | 1 | Gillnet around shoulders of pup; pup with a female in rookery area. | HK |
| 9/20 | Zapadni Reef | B | 200 | 0 | - | HK |
| 9/21 | Zapadni Reef | B | 200 | 1 | Blue net on neck (probably female); net twine diameter approximately 0.6 cm; no open wounds. | HK |
| 9/22 | Zapadni Reef | B | 200 | 0 | - | HK |
| 9/23 | Zapadni Reef | B | 200 | 0 | - | HK |
| 9/24 | Zapadni Reef | B | 200 | 0 | - | HK |
| 9/25 | NEP | B & H | - | 0 | - | HK |
| 9/25 | Zapadni Reef | B & H | 200 | 0 | - | HK |

Table B-10. -- Continued.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|------|-----------------------|--|--|---|--|-----------------------------------|
| 9/25 | Little Zapadni | H | 50 | 0 | - | HK |
| 9/25 | Polovina | B | 300 | 0 | - | HK |
| 9/26 | Zapadni Reef | H | 200 | 1 | Green net on neck of young seal (probably male). | HK |
| 9/26 | Tolstoi | H | 200-300 | 3 | 1) Green/white net around neck of young male. 2) Scar on neck of young male; scar 3-4 cm wide. 3) Green net on young male; deep wound; net twine diameter approximately. 0.6 cm; strands dangling. | HK HK |
| 9/26 | Zapadni Reef | B | 700-800 | 1 | Gillnet on young female; black and white whiskers. | HK |
| 9/27 | NEP-W | B | 500 | 0 | - | HK |
| 9/27 | NEP-W | H | 150-200 | 2 | 1) Green net around neck of male seal; small quantity of net. 2) Blue net around neck of male seal. | HK |
| 9/27 | Zapadni Reef | B | 150 | 1 | Gillnet around neck/shoulder of pup; same seal as 9/19; pup was nursing. | HK |
| 9/27 | Lukanin | B | 100 | 0 | - | HK |

Table B-10. --Continued.

| Date | Location ^a | Haul-out (H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|-------|-----------------------|---|--|---|--|-----------------------------------|
| 9/29 | Tolstoi | B | 1200-1500 | 1 | Gray net on female seal; large quantity of net; net had barnacles attached; black and white whiskers . | HK |
| 9/29 | Tolstoi | H | 200 | 0 | - | HK |
| 9/29 | Zolotoi Sands | H | 100 | 0 | - | HK |
| 9/30 | Zapadni Reef | B | 700-800 | 0 | - | HK |
| 10/23 | Zapadni Reef | H | - | 1 | Green net on subadult male; on neck; no visible wound. | PK |
| 10/24 | Reef | B | - | 5 | 1) Blue net on pup; on shoulders; no visible wound. 2) Green net on mixed-whiskered female ^c ; on neck trailing to ground; no visible wounds. 3) Green net on subadult male; on neck; no visible wound. 4) Green net on black-whiskered female ^c ; on neck; no visible wound. 5) Green net on white-whiskered female; on neck; 360° wound. | PK |
| 10/25 | NEP-E | - | - | 1 | Gray net on white-whiskered female; on neck; no visible wound. | PK |

Table B-10. -- Continued.

| Date | Location ^a | Haul-out(H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|-------|-----------------------|--|--|---|---|-----------------------------------|
| 10/26 | Kitovi | B | - | 2 | 1) Green net on white-whiskered female; on neck; no visible wound. 2) Unknown debris on white-whiskered female; on neck; 360° wound. | PK |
| 10/26 | Lukanin | B | - | 2 | 1) Blue net on black-whiskered female ^c ; on neck; no visible wound. 2) Blue net on black-whiskered female ^c ; on neck; no visible wound. | PK PK |
| 10/27 | Polivina Cliffs | - | - | 1 | Gray net on pup; on neck; no visible wound. | PK |
| 10/28 | Zapadni | B | - | 3 | 1) Unknown debris on black-whiskered female ^c ; on neck; 360° wound. 2) Green net on mix-whiskered female ^c ; on neck; 90° ventral wound. 3) Gray net on subadult male; on neck; 360 wound. | PK |
| 10/29 | Little Zapadni | - | - | 1 | Blue net on subadult male; on neck; no visible wound. | PK |

Table B-10. -- Continued.

| Date | Location ^a | Haul-out (H) or breeding area (B) | Estimated number of seals observed | Number of seals entangled or scarred | Description | Observer initials ^b |
|-------|-----------------------|---|--|---|---|-----------------------------------|
| 10/30 | Tolstoi | B | - | 6 | 1) Green net on black-whiskered female ^c ; on neck; no visible wound. 2) Green net on black-whiskered female ^c ; on low neck; no visible wound. 3) Blue net on black-whiskered female ^c ; on low neck; no visible wound. 4) Unknown debris on black-whiskered female ^c ; on neck; no visible wound, but animal lethargic. 5) Unknown debris on white-whiskered female; on low neck; no visible wound, but animal lethargic. 6) Green net on black-whiskered female ^c ; on neck; no visible wound. | PK |

^a See Figure 1; Footnote (a) in Appendix Table B-1. All sightings were on St. Paul Island, except where noted.

^b Observers: JS=Joe Scordino; NB=Norihisa Baba; AF=Akira Furuta; PK=Patrick Kozloff; HK=Hiroshi Kajimura; SZ=Steven Zimmerman.

^c Seals classified as mix-whiskered or black-whiskered females may actually be subadult males that were indistinguishable from young females.

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APPENDIX C

Scientific staff engaged in northern fur seal research in 1985

National Marine Mammal Laboratory (NMML)
 Howard W. Braham, Director
 Robert V. Miller, Deputy Director
 Charles W. Fowler, Manager, Fur Seal Program

| Name | Affiliation | Assignment |
|---------------------|-------------|--|
| <u>Permanent</u> | | |
| Patrick Kozloff | NMML | Population Assessment |
| Hiroshi Kajimura | NMML | Population Assessment |
| Laurie L. Briggs | NMML | Population Assessment |
| John L. Bengtson | NMML | Population Assessment |
| Roger L. Gentry | NMML | Behavior and Biology |
| Robert L. DeLong | NMML | Entanglement and and Feeding Behavior |
| Michael E. Goebel | NMML | Entanglement and Feeding Behavior |
| George A. Antonelis | NMML | Foraging Behavior and Food Habits |
| Thomas R. Loughlin | NMML | Pelagic Studies and Biology |
| Michael A. Perez | NMML | Pelagic Studies and Biology |
| Anne E. York | NMML | Population Dynamics |
| <u>Temporary</u> | | |
| Robin Manasse | NMML | Entanglement Studies |
| Jason Baker | NMML | Tooth Studies |
| Wendy E. Roberts | NMML | Behavior and Biology |
| Jason W. Simeonoff | NMML | Population Assessment |

APPENDIX C (Continued)

| Name | Affiliation | Assignment |
|--------------------------------|--|--------------------------------|
| Mamant Kochergin | NMML | Population Assessment |
| Isaac Zacharof | NMML | Population Assessment |
| Robert M. Olsen | NMML | Population Assessment |
| Andrew R. Lestenkof | NMML | Population Assessment |
| Alfey L. Hanson | NMML | Population Assessment |
| Mekey E. Borenin | NMML | Population Assessment |
| Amos T. Philemonoff | NMML | Population Assessment |
| Charles A. Melovidov | NMML | Population Assessment |
| Anthony Philemonoff | NMML | Population Assessment |
| Jason Bourdukofsky, Jr. | NMML | Population Assessment |
| Richard L. Merrick | NMML | Pelagic Studies and Biology |
| <u>Cooperators^a</u> | | |
| Joe Scordino | NWR ^b | Fur Seal Entanglement |
| John M. Francis | Univ. Calif., Santa Cruz | Behavior and Biology |
| Brent S. Stewart | Hubbs Marine Research Inst., San Diego, Calif. | Behavior and Biology |
| Steven Jeffries | Wash. Dept. Game | Pup Tagging Project |
| Robin Brown | Oreg. Dept. Game | Pup Tagging Project |
| Douglas Skilling | Oreg. St. Univ., Corvallis | Pup Tagging Project |
| Gene Berry | Oreg. St. Univ., Corvallis | Pup Tagging Project |

APPENDIX C (Continued)

| Name | Affiliation | Assignment |
|------------------|---|------------------------------|
| Jeff Barlow | Oreg. St. Univ., Corvallis | Pup Tagging Project |
| Wayne Perryman | SWFC ^C , La Jolla, Calif. | Foraging Behavior Studies |
| John Scholl | Calif. Dept. Fish & Game | Foraging Behavior Studies |
| Jan Roletto | Calif. Marine Mammal Center, Fort Cronkhite | Foraging Behavior Studies |
| Kazumoto Yoshida | Far Seas Fish. Res. Lab., Shimizu, Japan | Fur Seal Entanglement |
| Norihisa Baba | Far Seas Fish. Res. Lab., Shimizu, Japan | Fur Seal Entanglement |
| Shigeru Nomura | Izu-Mito Sea Paradise, Numazu, Japan | Fur Seal Entanglement |
| Akira Furuta | Izu-Mito Sea Paradise, Numazu, Japan | Fur Seal Entanglement |

^a Financed wholly or in part by the National Marine Mammal Laboratory or other agency.

^b NWR = NMFS Northwest Regional Office.

^C SWFC = NMFS Southwest Fisheries Center.